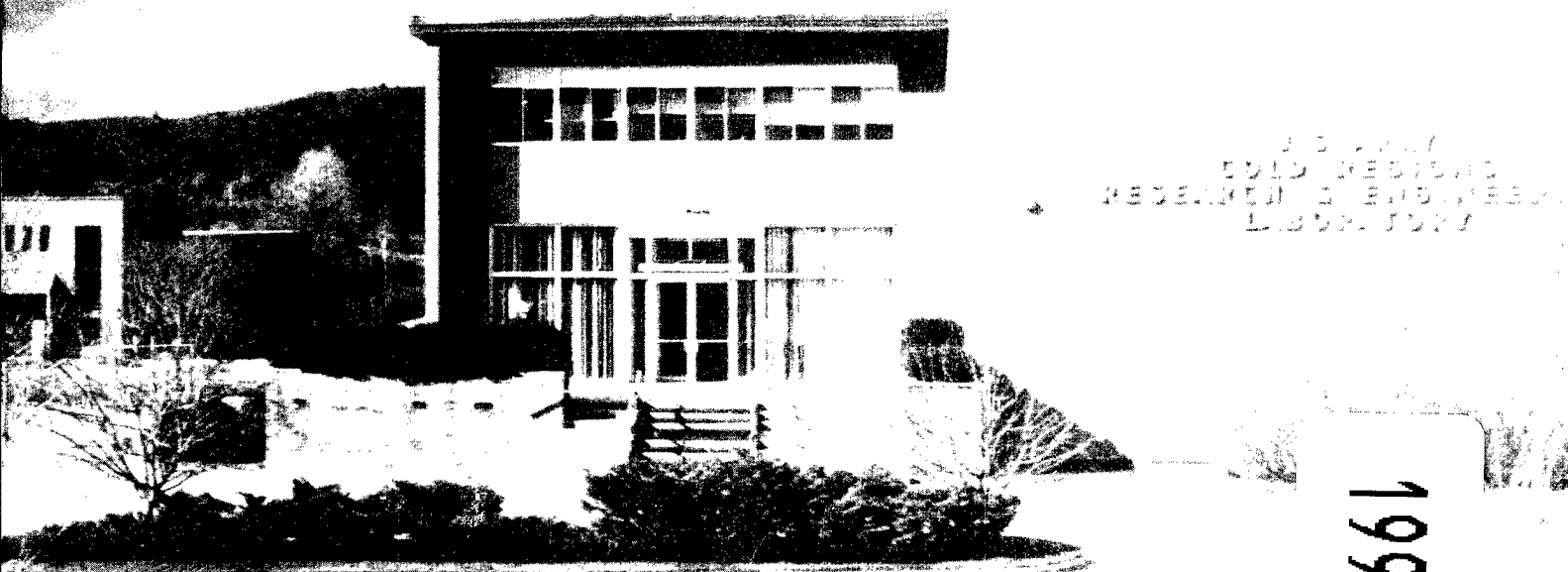


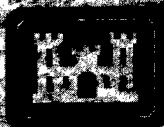
CRREL Technical Publications

Supplement October 1990 - September 1996



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CRREL Scientific and Technical Reports

Effective scientific and technical research depends on the transfer of information throughout the scientific community as well as the general dissemination of information to the public. CRREL has maintained an active publication program since its inception. This publication list is the supplement to the CRREL Publications List dated 1976-1990. The following descriptions are meant to clarify the CRREL report series.

CRREL Reports

The results of all major research efforts at CRREL are published in the CRREL report series.

Special Reports

The Special Report series contains a wide variety of reports that do not fall within the CRREL Report category, e.g. literature reviews, data compilations, interim reports.

Monographs

The Cold Regions Science and Engineering Monograph series comprises comprehensive reviews of a field of scientific or technical knowledge with analysis and evaluation. This series is not published on a regular basis and the numbers and frequency vary from year to year. This series would be considered classics in the field of cold regions science and engineering.

Miscellaneous Publications

This series includes papers by CRREL authors that are published outside the laboratory but under CRREL funding. This series would include conference proceedings, contract reports, and journal articles.

Internal Reports and Technical Notes

Internal Reports are not listed in our publications list but frequently are referred to in literature cited by CRREL authors. These documents have not been published for reasons such as proprietary information, excessive expense, limited interest, or awkwardness of format. Copies are available for review in the CRREL Library or with the author's explicit release. Technical Notes are informal, preliminary, unedited, and frequently superceded by a more formal CRREL publication. These are also not available for external distribution without prior permission from the author.

Bibliography on Cold Regions Science and Technology

The *Bibliography on Cold Regions Science and Technology* has been sponsored at the Library of Congress by CRREL since 1951. This most important CRREL product has been published in volumes 1-15 as the *Bibliography on Snow, Ice and Permafrost*, SIPRE Report 12. Beginning with volume 16 the title was changed to *Bibliography on Snow, Ice and Frozen Ground*, with abstracts, and with volume 23 the current title was adopted. This publication differs from the CRREL Publications List because it includes

all the world's cold regions research in addition to the CRREL in-house work.

Almost all the literature cited in the *Bibliography on Cold Regions Science and Technology* has been microfiched and is available in full text from the Library of Congress. If your requests number fewer than 10 you may borrow documents from the CRREL Library, 72 Lyme Road, Hanover, New Hampshire 03755-1290. Those interested in purchasing a photocopy of a document cited should write to the Library.

The *Bibliography* is available in the following three formats:

- Online searching is offered as FILE COLD through Questel-Orbit Search Service, 8000 Westpark Drive, McLean, Virginia 22102 (phone 703-442-0900 or 800-445-7248).

- A CD-ROM version, *Arctic and Antarctic Regions*, is available from NISC, Suite 6, Wyman Towers, 3100 St. Paul St., Baltimore, Maryland 21218 (phone 410-243-0797 or FAX 410-243-0982).

- The paper version currently in 50 volumes is available for purchase from the National Technical Information Service (NTIS), Springfield, Virginia 22161 (phone 703-487-4650). The annual volume appears in two parts: author/subject index and the numerical listing. Periodically, a multi-year author/subject index is published to simplify the search process.

Prior to publication in an annual volume, the monthly accessions to the *Bibliography on Cold Regions Science and Technology* are available for viewing on the CRREL Library Home Page: www.crrel.usace.army.mil/library.

The CRREL Reports, Special Reports and Monographs are all available for purchase from the National Technical Information Service (NTIS), Springfield, Virginia 22161. The telephone number is 703-487-4650. Please refer to the next page for ordering information, or copy the form.

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CRREL REPORTS

CR 82-43 RADAR DETECTION OF ICE WEDGES IN ALASKA.

Arcone, S.A., Sellmann, P.V., Delaney, A.J., Dec. 1982, 15p., ADA-124 571, 27 refs.

45-3021

ICE WEDGES, LAND ICE, RADAR, RADIO ECHO SOUNDINGS, REFLECTIVITY

The radar signatures of ice wedges and wedge-like structures have been investigated for a variety of soil conditions. The radar used for this study emitted short sinusoidal pulses of about 10-ns duration with an approximate center frequency of 150MHz. Most of the ice wedges existed at depths of about 1 m in a variety of silty and sandy soils with both frozen and thawed active layers. The position of the wedges was usually identified from corresponding surface features. An artificial ice wedge in coarse-grained alluvium was also profiled as well as wedge-like structures of fine silt in a coarse-grained glacial outwash. All wedges and wedge-like structures produced a hyperbolic reflection profile except when an active layer of thawed, saturated silt was present which eliminated returns from the wedges. The peaks of the hyperbolas were sometimes masked by reflections from the permafrost table or other material interfaces, and multiple hyperbolas occurred at some sites. The dielectric constant of the host medium was often calculated from the linear portions of the hyperbolas and the results were verified by laboratory time domain reflectometry measurements performed on field samples. In some cases, hyperbolic profiles originated at several meters depth suggesting that deep ice wedges could be detected in areas of cold permafrost.

CR 89-24

SUITABILITY OF THREE INTRUSION-DETECTION SYSTEMS FOR COLD REGIONS USE.

Peck, L., Dec. 1989, 37p.

49-386

DETECTION, SENSORS, COLD WEATHER OPERATION, ENVIRONMENTAL IMPACT, ACCURACY

The detection capabilities of two video motion-detection systems (Adpro, DAVID) and a fence-mounted capacitance sensor (Multiwire G-Line) have been determined under cold regions conditions at an intrusion detection system (IDS) test site in South Royalton, VT. Environmental effects on the performance of the IDS are reviewed. Alarm histories, including controlled intrusions and nuisance and false alarms, are presented.

CR 90-02

LABORATORY TEST FOR MEASUREMENT OF ADHESION STRENGTH OF SPRAY ICE TO COATED FLAT PLATES.

Mulherin, N.D., Richter-Menge, J.A., Tantillo, T.J., Gould, L.D., Durrell, G.D., Elder, B.C., May 1990, 44p., ADA-228 559, 17 refs.

45-976

PROTECTIVE COATINGS, ICE REMOVAL, LABORATORY TECHNIQUES, SHIP ICING, SEA SPRAY, ICE ADHESION, CHEMICAL ICE PREVENTION

Four commercial icephobic coatings were selected as candidates for preventing and/or easing the removal of seaspray and atmospheric icing on shipboard superstructures. This study was undertaken to compare the force required to shear freshwater ice from flat test plates coated with the candidate materials. Twelve replicates each of the four different coatings and two different control surfaces (a total of 72 samples) were subjected to laboratory spray icing. The samples were iced and shear tested at -10 ± 1 C at a constant crosshead displacement rate of 0.0381 cm/s. This shear rate was higher by at least an order of magnitude than that in most previous shear studies, ensuring a brittle failure at the ice/coating interface. The method produced virtually 100% ice/coating adhesion in every test, which eliminated analysis problems associated with cohesive failure. Results showed that all four of the experimental coatings exhibited higher mean shear values than either of the two controls. Although the mean shear values for the various coatings were very similar in absolute magnitude, ranging from 71 to 119 kPa, statistical analysis showed a significant difference in surface performance with greater than 97% confidence.

CR 90-03

HEAT TRANSFER FROM WATER FLOWING THROUGH A CHILLED-BED OPEN CHANNEL.

Richmond, P.W., Lunardini, V.J., May 1990, 52p., ADA-226 855, 30 refs.

49-295

HEAT TRANSFER, ICE COVER, WATER FLOW, ICE WATER INTERFACE

Observations and experiments have shown that heat transfer is greater for water flowing over ice than for water flowing over flat plates without melting. The mechanisms that contribute to this increased heat transfer are not completely understood. One possible cause is the density inversion of water at 4 C. In order to investigate

this effect on heat transfer, a small open-channel flume was designed and constructed. Experiments were conducted with the flume bed at temperatures slightly above 0 C and at temperatures above 4 C. Bulk water temperatures ranged from 5 to 33 C. Flow data were obtained for $2.5 \times 10^3 < ReH < 10^5$. At high flow rates (fully developed turbulent flow) heat transfer correlations were determined and compared with other correlations. The correlations obtained from these experiments initially showed higher heat transfer rates than those obtained from experiments in larger flumes with ice present. This is thought to be due to a difference in velocity profiles caused by the flume width. Once velocity corrections were made to the data, they agreed more closely with experiments from wider flumes. The results indicate that the density inversion of water could account for most of the increased turbulent heat transfer observed between melting and non-melting systems. The heat transfer data at low flow rates are more qualitative than quantitative due to difficulty in obtaining accurate data.

CR 90-04

MORPHOMETRIC ANALYSES OF RECENT CHANNEL CHANGES ON THE TANANA RIVER IN THE VICINITY OF FAIRBANKS, ALASKA.

Collins, C.M., June 1990, 48p., ADA-229 511, Refs. p.29-32.

49-296

BANKS (WATERWAYS), RIVERS, EROSION, SEDIMENTATION, UNITED STATES—ALASKA—TANANA RIVER

Long-term bank erosion rates and channel changes in a 14 km stretch of the Tanana River centered on Goose I. were documented using historical aerial photography from 1938 through 1982. The construction effects of a causeway partially blocking the river and the time required to return to equilibrium after construction were studied. Erosion, averaged over the entire study reach, was not significantly different following causeway construction compared to that prior to construction. Significant short-term increases in localized erosion rates during post- vs. pre-construction time periods were documented in south channels and islands downstream of the causeway. Deposition upstream of the river construction formed by the causeway was dramatic. The Tanana River returned to near equilibrium by 1980, five years after the construction of the causeway, with some effects continuing in 1982. Due to additional in-river construction downstream of the study area in 1981, the separate effects from the causeway could not be monitored beyond 1982.

CR 90-06

LABORATORY INVESTIGATION OF THE USE OF GEOTEXTILES TO MITIGATE FROST HEAVE.

Henry, K.S., Aug. 1990, 28p., ADA-227 335, 27 refs.

45-841

SOIL WATER, FROST HEAVE, COUNTERMEASURES, HYDRAULICS, FROST PENETRATION, PAVEMENTS, GEOTEXTILES

Frost action beneath pavements can lead to several problems, including thaw weakening, which leads to cracking and subsequent pumping of fine soil particles onto the surface, as well as hazardous conditions caused by differential heaving. This study utilized data and frost-susceptible soil collected at Ravalli County Airport, Hamilton, Montana, to study the use of geotextiles to mitigate frost heave. The ability of geotextiles to reduce frost heave in subgrade material by creating a capillary break was assessed by inserting disks of fabric in soil samples and subjecting them to laboratory frost heave tests. Frost heave tests were also conducted to classify the frost susceptibilities of soils at the airport. Soil moisture characteristics and unsaturated hydraulic conductivities were determined for soils tested as well as for one of the geotextiles used. Results of the laboratory investigation indicate that certain geotextiles show promise for use as capillary breaks. In laboratory tests, the presence of geotextiles led to the reduction of frost heave by amounts up to about 60%. It is speculated that the capillary break action provided by the geotextile is attributable to the pore size and structure of the material and the surface properties of the fibers.

CR 90-07

LONGITUDINAL FLOATING ICE CONTROL STRUCTURES: A NEW CONCEPT FOR REDUCING ICE JAM FLOOD LEVELS.

Calkins, D.J., Sep. 1990, 9p., ADA-228 561, 14 refs.

45-975

FLOATING STRUCTURES, ICE BOOMS, ICE CONTROL, ICE JAMS, RIVER ICE

A floating ice control structure placed in the streamwise direction of a river was analyzed to determine its effectiveness in reducing ice jam thicknesses. The theory describing the thickness for river ice jams was modified to analyze these longitudinal structures, providing the computational verification that ice jam thicknesses could be reduced where the mode of thickening is internal collapse. These longitudinal structures may provide a new tool to use in modifying

the river ice regime, both at freeze-up and break-up. The concept was applied to the Salmon River at Salmon, Idaho, where it was estimated that a 0.9 m drop in river stage was possible using one structure in the center of the channel.

CR 90-08

ESTIMATES OF SHOCK WAVE ATTENUATION IN SNOW.

Johnson, J.B., Oct. 1990, 14p., ADA-230 180, 8 refs.

45-1550

MATHEMATICAL MODELS, ATTENUATION, SHOCK WAVES, SNOW MECHANICS, SNOW PHYSICS, SNOW COMPACTION

A simple momentum model, assuming that snow compacts to its final density at negligible stress, is used to estimate shock wave attenuation in snow. Four shock loading situations are examined: a one-dimensional pressure impulse of finite duration and instantaneously applied pressure impulses for one-dimensional, cylindrical and spherical shock geometries. Calculations show that while a finite-duration impulse is being applied, the shock pressure in snow is determined by the impulse pressure-time profile. After the pressure impulse has been applied, the one-dimensional shock pressure decay is the same as for an instantaneously applied pressure impulse and is proportional to the inverse square of the shock propagation distance. Hence, finite-duration pressure impulses delay the onset of shock attenuation in snow. This can result in more pressure attenuation near a shock source, where the positive phase duration of the shock is short, compared to shock waves farther from a source. Cylindrical waves have a maximum decay that is proportional to the inverse of the propagation radius to the fourth power, and spherical waves have a maximum decay that is proportional to $R \exp(-6R)$. Amplitude decay for cylindrical and spherical shock waves can vary from $(R-R(0)) \exp(-2)$, when $(R-R(0)) < R(0)$ (where $R(0)$ is the interior radius over which a pressure impulse per unit area is applied), to their maximum decay.

CR 90-09

WHEELS AND TRACKS IN SNOW: VALIDATION STUDY OF THE CRREL SHALLOW SNOW MOBILITY MODEL.

Blaisdell, G.L., Richmond, P.W., Shoop, S.A., Green, C.E., Alger, R.G., Nov. 1990, 72p., ADA-230 102, 10 refs.

45-1510

SNOW, SNOW STRENGTH, VEHICLES, TRACTION, COMPUTERIZED SIMULATION, MODELS, SNOW VEHICLES, TRACKED VEHICLES, TANKS (COMBAT VEHICLES), MILITARY EQUIPMENT, MOTOR VEHICLES

In 1986, a mobility model was developed for predicting the traction and motion resistance of both wheeled and tracked vehicles on shallow snow, and a winter field season was dedicated to gathering mobility data for a diverse family of vehicles (including four on wheels and three tracked) to validate the model. The original version of the model, SSM1.0, used the Mohr-Coulomb shear failure equation from soil mechanics to predict gross traction. This required input of the snow strength parameters c and ϕ . Motion resistance is predicted by calculating the amount of work done by the tire in compacting snow and only requires snow depth and density values as input snow properties. Some effort was expended in determining an easy and reliable method of obtaining snow strength parameters. The model was originally designed to use an initial snow density-snow strength relationship established from past instrumented vehicle test results. Historically, shear annulus apparatus have been used to obtain Mohr-Coulomb strength parameters. A comparison of snow strength obtained via these three methods (shear annulus, instrumented vehicle, calculated from initial density using the relationship in SSM1.0) for individual snow covers showed no agreement. SSM1.0 assumed that snow strength parameters for mobility prediction were a function of initial snow density; however, traction is developed in the compacted snow under the driving element, whose strength properties bore little relation to those of the initial snow. It appears that the shear strength of the compacted snow is essentially a constant for all of the vehicles and snow covers tested here.

CR 90-10

PREDICTING THE BEHAVIOR OF ASPHALT CONCRETE PAVEMENTS IN SEASONAL FROST AREAS USING NONDESTRUCTIVE TECHNIQUES.

Janoo, V.C., Berg, R.L., Nov. 1990, 56p., ADA-231 292, 16 refs.

45-1699

BITUMINOUS CONCRETES, LABORATORY TECHNIQUES, CONCRETE PAVEMENTS, FROST HEAVE, THAW WEAKENING, THAW DEPTH, FREEZE THAW TESTS

Four different pavement test sections were subjected to freeze-thaw cycling in CRREL's Frost Effects Research Facility (FERF). The test sections, each 610 cm in length, consisted of 1) 15.2 cm of

asphalt concrete pavement over a clay subgrade, 2) 15.2 cm of asphalt concrete over 10.2 cm of crushed gravel over a clay subgrade, 3) 5.1 cm of asphalt concrete over 25.4 cm of crushed gravel over 12.7 cm of clean sand over a clay subgrade. Thermocouples were imbedded throughout the pavement structure and subgrade. During the thawing periods, deflection measurements were made at four locations in each test section using a Dynatest Falling Weight Deflectometer (FWD). The results of the deflection measurements are presented here. An analysis was done to quantify the subgrade strength based solely on FWD measurements. It was also shown that a relationship existed between thaw depth and FWD measurement in the subgrade.

CR 90-11

UHF MODEL SIMULATION OF DETECTING VOIDS IN A DIELECTRIC MEDIUM USING HF-VHF AIRBORNE SHORT-PULSE RADAR.
Arcone, S.A., Dec. 1990, 12p., ADA-231 495, 23 refs.

49-297

AIRBORNE RADAR, BEDROCK, ICE ELECTRICAL PROPERTIES, DIELECTRIC PROPERTIES, WATER SUPPLY, SIMULATION

A model study of the interaction between airborne-launched short-pulse radar signals and three sizes of rectangular voids in bedrock was conducted to see if polarization perpendicular to the strike of the voids could be used for detection, and if any characteristic waveform such as resonance could be associated with any of the void responses. Radar wavelets with frequency spectra centered at about 870 MHz illuminated three square Styrofoam (relative dielectric constant less than 1.1) strips, 5, 10 and 20 cm on a side, emplaced in a sand (relative dielectric constant of 5.9) box, 1 m deep, 4.5 m long and 2.5 m wide. This setup modeled the interaction of 22-, 44- and 87-MHz wavelets with voids having widths of 2 m and situated in a crystalline type of bedrock. The antennas traversed 23-85 cm above the sand surface and data were recorded continuously at 25.6 scans/s. Polarization both parallel and perpendicular to the long axis of the voids produced reflections with apparently undistorted wavelets and hyperbolic spatial distributions, with the strongest response for the perpendicular over the 10 cm void. Although real HF signal attenuation was not simulated in this model, the results suggest that under these nearly ideal conditions of a homogeneous void matrix of low conductivity with a flat surface, a 2 m void at a 10 m depth could be detected easily with a moderately powered transmitter at a 10 to 12 m altitude using a 40 to 50 MHz short pulse polarized perpendicular to the void axis.

CR 90-12

WINTER ENVIRONMENT OF THE OHIO RIVER VALLEY.

Daly, S.F., Bilello, M.A., Bates, R.E., Dec. 1990, 57p., ADA-232 134, 26 refs.

45-1999

RIVER ICE, CLIMATIC FACTORS, AIR TEMPERATURE, WATER TEMPERATURE, ICE CONDITIONS, UNITED STATES—OHIO RIVER

A general survey of the winter environment of the Ohio River Valley that is relevant to river ice formation is described. Included are hydrologic, hydraulic and climatic conditions. The long-term monthly discharges steadily increase on the Ohio River throughout the winter season. Inspection of the discharges for each day shows that it has a large short-term variability during the winter, with peaks being four to six times the base flow, and generally coinciding with higher air temperatures. River water temperatures follow a yearly cycle that can be closely described by a sinusoidal curve. The river water temperatures have their minimum in Jan., and also exhibit Jan. "thaws." Ice conditions on the Ohio River are quite variable. The number of days with ice each winter has gradually and erratically decreased from 1902 to 1975. The cause of this decrease cannot be determined, but there is a direct correlation with watershed development, as indicated by watershed population. Average air temperatures show a good correlation with elevation. Other points discussed are mean minimum air temperatures, freezing-degree days and precipitation.

CR 90-13

WHEELS AND TRACKS IN SNOW; SECOND VALIDATION STUDY OF THE CRREL SHALLOW SNOW MOBILITY MODEL.

Richmond, P.W., Blaisdell, G.L., Green, C.E., Dec. 1990, 39p., ADA-232 866, 8 refs.

45-2094

TRACTION, MILITARY EQUIPMENT, MOTOR VEHICLES, TIRES, SNOW STRENGTH, SNOW VEHICLES, VEHICLES, COMPUTERIZED SIMULATION, MODELS, TRACKED VEHICLES

This report presents and analyzes winter mobility data obtained during the winters of 1988 and 1989 at the Keweenaw Research Center, Houghton, MI. Traction data (1989) for the HMMWV, HEMTT, SUSV and M60 military vehicles, and the CRREL instrumented vehicle, are presented for hard-packed snow and for undisturbed snow overlaying ice. When these data are compared with an equation for undisturbed snow over soil or packed snow, slight reductions in traction are observed. Resistance data obtained in 1988 and in 1989 are evaluated based on a combined vehicle-snow parameter. An empirical equation based on this parameter and data from all the vehicles, including the CRREL instrumented vehicle using several

different width tires, is developed. The resistance data and the empirical resistance equation are compared with the CRREL shallow snow mobility (SSM2.0). The SSM2.0 predicted resistance is within 50% on average. The empirically derived resistance equation is slightly worse. The report recommends further research on vehicle motion resistance in snow.

CR 91-01

USE OF INSULATION FOR FROST PREVENTION: JACKMAN AIRPORT, MAINE, 1986-1987 WINTER.

Kestler, M.A., Berg, R.L., Jan. 1991, 45p., ADA-234 274, 5 refs.

45-2643

PAVEMENTS, FROST HEAVE, FROST PENETRATION, RUNWAYS, THERMAL INSULATION, FROST PROTECTION

In 1986, Newton Field, a small runway in Jackman, ME, was reconstructed using a 2 inch thick layer of extruded polystyrene insulation. At the same time, Nichols Road, a nearby town road, was reconstructed to a conventional, uninsulated cross section. Both Newton Field and Nichols Road were similarly monitored: thermocouples, tensiometers, and groundwater wells were installed during construction, and, following construction, a pavement surface elevation grid was established at each of the test sites for monitoring frost heave. This report discusses the performance of the insulated and uninsulated pavements during the first of four winters of observation.

CR 91-02

ROTATING MULTICYLINDER METHOD FOR THE MEASUREMENT OF CLOUD LIQUID-WATER CONTENT AND DROPLET SIZE.

Howe, J.B., Jan. 1991, 18p., ADA-234 780, 11 refs.

45-2642

AIRCRAFT ICING, CLOUD DROPLETS, UNFROZEN WATER CONTENT, MEASURING INSTRUMENTS

Since its development at the Mount Washington Observatory in the 1940s, the rotating multicylinder (RMC) method has been the simplest, most reliable, and usually the most accurate means of measuring the liquid-water content and droplet size in clouds and fog. The development history of the method is reviewed in this report. Fabrication of the instrument, exposure and data-reduction techniques, and the underlying theory of the method are described in detail. Accuracy of the RMC method is discussed and comparison tests with other instruments are briefly reviewed.

CR 91-03

COMPUTER MODEL OF ATMOSPHERIC ICE ACCRETION ON TRANSMISSION LINES.

Jones, K.F., Egelhofer, K.Z., Feb. 1991, 24p., ADA-234 273, 34 refs.

45-2641

ICE LOADS, WIND PRESSURE, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION, POWER LINE ICING, ICE ACCRETION

Atmospheric ice accretions on transmission lines cause increased gravity and wind loads on the lines. In regions subject to icing conditions, transmission line design must take these loads into account. This report describes a numerical model for determining the accretion of ice on transmission lines. The eccentric ice load causes a gradual rotation of the flexible conductor, which affects the shape and size of the accretion. The sensitivity of the gravity and wind load on the conductor to both atmospheric and structural variables is examined.

CR 91-04

LOW-TEMPERATURE EFFECTS ON THE DESIGN AND PERFORMANCE OF COMPOSTING OF EXPLOSIVES-CONTAMINATED SOILS.

Ayorinde, O.A., Reynolds, C.M., Mar. 1991, 29p., ADA-236 420, 68 refs.

45-2917

DECOMPOSITION, COLD WEATHER OPERATION, MILITARY FACILITIES, ANALYSIS (MATHEMATICS), SOIL POLLUTION, WASTE TREATMENT, EXPLOSIVES, MICROBIOLOGY

It is well known that energy, in the form of heat, is released through microbial conversion of chemical species in a compost system. This heat energy is a major factor in the performance of the compost system and the effects of climate, especially subfreezing temperatures, may require engineering controls. This report reviews the literature on the effects of cold climates on composting. The suitability of current compost system designs for remediating explosives-contaminated soils in cold regions is discussed and a theoretical heat balance is performed. Results indicate that cold climate composting may be performed with appropriate controls; however, lack of operational data for analysis requires reliance on theoretical models that may be overly simplified. The complex relationships between physical parameters in compost systems are also discussed.

CR 91-05

PERSONNEL AND CARGO TRANSPORT IN ANTARCTICA; ANALYSIS OF CURRENT U.S. TRANSPORT SYSTEM.

Blaisdell, G.L., Mar. 1991, 63p., ADA-236 142, 5 refs.

45-3109

AIRPLANES, HELICOPTERS, SLEDS, SNOW VEHICLES, TRANSPORTATION, TRACTORS, TRACKED VEHICLES, AIR CUSHION VEHICLES

An analysis of the National Science Foundation's surface vehicle fleet in Antarctica is reported on here. Surface vehicle needs have been determined through interviews of vehicle users, managers and maintainers, and from direct on-site observation. An ideal grouping of vehicle categories is proposed that will address current needs and provide flexibility for the future. Recommendations for streamlining and modernizing the NSF antarctic vehicle fleet are made. Cargo transportation over snow was identified as being in a crisis state. Personnel movement functions for all but traversing are performed adequately at this time, although there is much room for improvement. Brands and models must be selected for some categories of recommended vehicle types. This will naturally follow a more in-depth analysis of candidates and discussions with NSF vehicle managers. A purchasing plan, including a timetable, budget, and desired sequence of replacement, must then be formulated and executed. (Auth.)

CR 91-06

SLUDGE DEWATERING IN A FREEZING BED—A PILOT-SCALE STUDY.

Martel, C.J., Diener, C.J., Apr. 1991, 14p., ADA-235 995, 11 refs.

46-216

WATER TREATMENT, DESIGN, TEMPERATURE EFFECTS, COLD WEATHER TESTS, SLUDGES, WASTE TREATMENT, FREEZE THAW CYCLES, INSULATION, COLD WEATHER PERFORMANCE, MELT WATER

In 1986 a pilot-scale sludge freezing bed was constructed at the U.S. Army Cold Regions Research and Engineering Laboratory in Hanover, NH. This bed was operated over the next three years using both anaerobically and aerobically digested sludges. These tests demonstrated that both sludges can be effectively dewatered by this process. The final solid contents were 39.3% and 24.5% for anaerobically digested and aerobically digested sludges, respectively. The quality of the meltwater was similar to raw wastewater. Odors were not a problem if the meltwater was drained away as quickly as it formed. Both sludges were easily removed with a front-end loader. The actual depth of sludge frozen and thawed in the bed during each year of operation was very close to that predicted by design models.

CR 91-07

PERFORMANCE OF ASPHALT CONCRETE AIRPORT PAVEMENTS DURING THAW WEAKENING PERIODS; A FIELD STUDY.

Janoo, V.C., Berg, R.L., Apr. 1991, 68p., ADA-237 441, 13 refs.

45-2956

AIRPORTS, RUNWAYS, CONCRETE PAVEMENTS, THAW WEAKENING

It is accepted that in the winter the load-carrying capacity of pavements increases dramatically because of freezing of the pavement structure. This is more striking in asphalt concrete pavements because of the stiffening of the asphalt at low temperatures. In the spring, the pavement structure below the asphalt layer thaws and can become saturated with water from the melting ice lenses, reducing the strength of the base, subbase and subgrade. In the spring of 1986, CRREL conducted Falling Weight Deflectometer (FWD) measurements at an airfield in Wisconsin, which had pavements that were primarily asphalt concrete, to determine the change in the load-bearing capacity of these pavement structures in a seasonal frost area during thaw weakening periods. In addition to FWD measurements, surface and subsurface pavement temperatures were measured at selected sites. This report gives a general description of the airfield and the pavement structure and a comprehensive analysis of the FWD measurements.

CR 91-08

LOW TEMPERATURE DECONTAMINATION WITH DS2: STUDIES WITH CHEMICAL AGENT SIMULANTS.

Parker, L.V., Walsh, M.E., Apr. 1991, 23p., ADB-156 188, 19 refs.

45-3260

ICING, MILITARY RESEARCH, LOW TEMPERATURE RESEARCH, COLD WEATHER PERFORMANCE

Experiments were performed to determine factors that significantly influence the efficiency of DS2 for decontamination using chemical agent simulants. Several surface types and conditions that may be encountered on a winter battlefield were tested. The three simulants used in this study were: BIS, IDEM, and DMMP. Generally, decontamination was reduced at lower temperatures. At -29 C, the DS2 was extremely viscous, and scrubbing was required to spread the DS2 evenly over the contaminated area. The presence of dirt and oil significantly reduced decontamination efficiency in the cold, while the presence of ice did not adversely affect decontamination. Following decontamination, removal of the simulant was not enhanced by

rinsing surfaces with 100°C water, as opposed to 0°C water, but icing of the sample surfaces was reduced when hot water was used. As an alternative to an aqueous rinse, DS2 may be removed by wiping with a paper towel without decreasing removal efficiency. For the experiments performed on painted (alkyd and CARC) surfaces, two major differences were observed between the 22°C and -29°C tests: alkyd paint was not damaged by the DS2 at the low temperature and while decontamination efficiencies were equal on alkyd- and CARC-covered and unpainted metal surfaces at -29°C, they varied dramatically at 22°C. Based on the information available in the literature and from this study with simulants, decontamination with DS2 and a water rinse is not practical at temperatures much below -30°C. At these low temperatures, the logistics of dispensing the DS2 and rinsing it away with water become unreasonable.

CR 91-09 REMOTE SENSING OF SNOW COVERS USING THE GAMMA-RAY TECHNIQUE.

Offenbacher, E.L., Colbeck, S.C., Apr. 1991, 19p., ADA-238 016, 28 refs.

45-3259
REMOTE SENSING, SNOW WATER EQUIVALENT, SNOW COVER, SNOW SURVEYS, AERIAL SURVEYS
This report reviews various aspects of the use of natural gamma-ray emissions to determine the mass of snow covering the ground. The interactions of gamma rays with water mass are described, along with the various sources of gamma radiation from the ground. Different possible techniques for measuring gamma radiation are described. Each has advantages and disadvantages in obtaining the desired result. The source of error and the use of this method are described.

CR 91-10 IMPULSE RADAR BATHYMETRIC PROFILING IN WEED-INFESTED FRESH WATER.

Kovacs, A., Apr. 1991, 19p., ADA-237 489, 20 refs.

45-2955
SOUNDING, RADAR, UNDERWATER ACOUSTICS
An evaluation of an impulse radar sounding system for profiling bottom topography in weed-infested waters is discussed. Field results are presented comparing radar profiles of water depth with those obtained with a conventional acoustic depth sounder. It was found that the impulse radar system could profile freshwater depths through dense vegetation, whereas the acoustic depth sounder could not.

CR 91-11 INTERPRETATION OF PASSIVE MICROWAVE IMAGERY OF SURFACE SNOW AND ICE—HARDING LAKE, ALASKA.

Melloh, R.A., Eppler, D.T., Farmer, L.D., Gatto, L.W., Chacho, E.F., Jr., June 1991, 30p., ADA-239 140, 24 refs.

46-44
PHOTOINTERPRETATION, SURFACE PROPERTIES, CORRELATION, BRIGHTNESS, LAKE ICE, ICE CONDITIONS, AERIAL SURVEYS, IMAGING, SNOW COVER EFFECT, RADIOMETRY, MICROWAVES
This report presents interpretations of snow and ice conditions on Harding Lake, Alaska, using 33.6-GHz passive microwave imagery acquired from 1500 m on 8 and 11 March 1988, when snow conditions were dry and wet, respectively. Field data used include an aerial video mosaic, ice column descriptions, snow observations and an impulse radar trace. Results show that low-altitude passive microwave imagery is a promising method for remote/field investigation of large-scale lake ice processes. Fracture patterns in the lake ice were detected where snow ice had formed above and near cracks in the ice cover. Presumably, bubbles in the snow ice layer scattered less energy than the depth hoar crystals over the adjacent ice surface, resulting in warmer brightness temperatures over the fractures. Brightness temperatures of a continuous and deeper snowcover at the northwest end of the lake were low compared to the combined radiance of snowdrifts and pockets of bare ice across the lake surface.

CR 91-12 EVALUATION OF A PORTABLE ELECTROMAGNETIC INDUCTION INSTRUMENT FOR MEASURING SEA ICE THICKNESS.

Kovacs, A., Morey, R.M., June 1991, 17 refs., ADA-240 974, 12 refs.

46-262
ICE SURVEYS, SEA ICE, MEASURING INSTRUMENTS, ICE COVER THICKNESS, ELECTROMAGNETIC PROSPECTING, SOUNDING
Field trials using a man-portable Geonics, Ltd., EM31 electromagnetic induction sounding instrument, with a plug-in data processing module, for the remote measurement of sea ice thickness, are discussed. The processing module was made by Flow Research, Inc., to directly measure sea ice thickness and show the result in a numerical display. The EM31-processing module system was capable of estimating ice thickness within 10% of the true value for ice from about 0.7 to 3.5 m thick, the oldest undeformed ice in the study area. However, since seawater under the arctic pack ice has a relatively uniform conductivity (2.5 +/- 0.05 S/m), a simplified method, which can be used for estimating sea ice thickness using just an EM31 instrument, is discussed. It uses only the EM31's conductivity measurement, is

easy to put into use and does not rely on theoretically derived look-up tables or phasor diagrams, which may not be accurate for the conditions of the area.

CR 91-13 POTENTIAL INFLUENCES OF COMMON WELL CASINGS ON METAL CONCENTRATIONS IN WELL WATER WITH LOW DISSOLVED OXYGEN.

Hewitt, A.D., July 1991, 17p., ADA-241 014, 12 refs.

46-266
WATER CHEMISTRY, ENVIRONMENTAL PROTECTION, LEACHING, WELL CASINGS, GROUND WATER, WATER POLLUTION

Both the leaching and sorption characteristics of poly(vinyl chloride) (PVC), poly(tetrafluoroethylene) (PTFE) and two types of stainless steel (SS 304 and SS 316) well casing materials were examined by determining levels of Cd, Cr, Cu, Pb, Fe and Ni in an aqueous solution. Experiments were conducted under a nitrogen environment in well water having low dissolved oxygen, without visible surface oxidation of the stainless casings. Under conditions typical of deep wells, PTFE was inert, whereas both stainless steels significantly altered the solution chemistry for most of the metals cited above. PVC was generally more reactive than PTFE, but did not dominate solution chemistry; neither was it as variable in its influence as the metal casings.

CR 91-14 GROUNDWATER-DISCHARGE WETLANDS IN THE TANANA FLATS, INTERIOR ALASKA.

Racine, C.H., Walters, J.C., July 1991, 10p., ADA-241 282, 28 refs.

46-1048
VEGETATION PATTERNS, PERMAFROST HYDROLOGY, RIVER BASINS, DRAINAGE, THERMOKARST, WETLANDS, GROUND WATER, SWAMPS, UNITED STATES—ALASKA—TANANA RIVER

In the northwest corner of the Tanana Flats, a lowland basin just south of Fairbanks, there is a vast network of floating-mat wetlands or fens that appear to be unique in terms of their origin, large areal extent, and absence of *Sphagnum* moss and associated peat. These wetlands consist of a floating vegetation mat up to 1 m thick, forming an almost complete cover over deeper water bodies. The mats consist of a tall, dense and productive network of emergent vascular plants. Evidence that these wetlands are formed by groundwater discharge includes a) the apparent absence of permafrost under these wetlands but its presence on the adjacent forested uplands, b) nearby winter icings resulting from artesian springs, c) the relatively high pH, conductivity, calcium and magnesium concentrations of the water, d) the vascular plant species composition and in particular the absence of *Sphagnum* moss, and e) the flow of water and the geological history of the area. Expansion of these fens in several places is suggested by dead and dying white birch along the along-fen margin, where permafrost thaw and subsidence (thermokarst) is taking place.

CR 91-15 INVESTIGATIONS OF FRESHWATER AND ICE SURVEYING USING SHORT-PULSE RADAR.

O'Neill, K., Arcone, S.A., July 1991, 22p., ADA-241 035, 18 refs.

46-1047
AERIAL SURVEYS, LAKE ICE, RIVER ICE, ICE WATER INTERFACE, ANALYSIS (MATHEMATICS), ICE SURVEYS, ICE COVER THICKNESS, RADAR ECHOES
An overview is presented of recent activities and results in the use of commercially available short-pulse UHF radar for surveying ice conditions on freshwater bodies. Improvements in radar systems have made it possible to increase ice thickness resolution by as much as one third relative to that in past attempts, and some new signal processing approaches shown here may offer an order of magnitude improvement. Results from airborne surveying are shown. An algorithm is presented that locates returns from interfaces in the presence of noise for a non-minimum delay wavelet. The method performs a simple inversion in the frequency domain, enhanced by a time dependent weight designed to recognize the shape of the wavelet amplitude and phase spectra. Thin ice layers are resolved down to a few centimeters and are distinguished from an ice-free condition by means of a matched filter system designed to recognize the interference pattern from parallel interfaces close to one another.

CR 91-16 NUMERICAL MODELS FOR FORECASTING ICE CONDITIONS ON THE OHIO RIVER.

Shen, H.T., Bjedov, G., Daly, S.F., Lal, A.M.W., Sep. 1991, 55p., ADA-243 336, 20 refs.

46-1869
ICE JAMS, WATER TEMPERATURE, ICE MODELS, MATHEMATICAL MODELS, ICE COVER, COMPUTERIZED SIMULATION, RIVER ICE, FRAZIL ICE, ICE CONDITIONS, ICE FORECASTING, ICE NAVIGATION, THEORIES, UNITED STATES—OHIO RIVER

A numerical model, RICEOH, for simulating flow and ice conditions in a dendritic river system is developed. The flow computations use a double-sweep algorithm for unsteady shallow-water wave equations. The distributions of water temperatures and ice concentration are determined using a Lagrangian-Eulerian scheme. The formation of an ice cover is modeled using existing equilibrium ice jam theories.

Frazil ice deposition and erosion are modeled by a simple critical-velocity criterion. The thermal growth and decay of an ice cover is calculated by a quasi-steady finite-difference method. The model is applied to the Ohio River system between Pittsburgh, PA, and Meldahl, OH. Comparisons with field observations show that the model can provide good simulation for ice conditions.

CR 91-17 GEOPHYSICAL INVESTIGATIONS OF AN ANOMALOUS UNFROZEN ZONE, CARIBOU PEAK, ALASKA.

Lawson, D.E., Arcone, S.A., Collins, C.M., Oct. 1991, 23p., ADA-244 257, 34 refs.

46-1870
GROUND WATER, PERMAFROST DISTRIBUTION, PERMAFROST HYDROLOGY, TALIKS, GEOPHYSICAL SURVEYS, UNITED STATES—ALASKA—CARIBOU PEAK

The occurrence of unfrozen materials and groundwater flow on a north-facing slope in interior Alaska is important to recognize, both for predicting the spatial distribution of perennially frozen ground as well as for understanding watershed hydrology. An anomalous unfrozen zone or talik was located on the northern slope of Caribou Peak by drilling in Apr. 1985. Impulse radar surveying of the area immediately adjacent to this drill hole, as well as on three transects upslope of its location, revealed that the unfrozen zone is the result of groundwater flow in the bedrock along a relatively planar zone, interpreted as a fracture. This fracture and two others located by the radar are continuous in the direction of the slope, trending generally N20E and dipping about 9E. Geologic logs indicate that the drill hole intersected a fracture in the bedrock, a quartz-muscovite schist, at a depth of about 8.5 to 9.0 m. Downhole measurements show ground temperatures at this depth are generally uniform and slightly above freezing throughout the year, suggesting continuous flow of groundwater within the planar structure. Analysis of the freezing point of the groundwater sample indicates normal freezing beginning at 0°C, while ion chromatography indicated that the water was fresh and not highly mineralized. Vegetation patterns, coupled with the borehole location and fracture orientation, suggest that flow originates within the upper and central parts of the peak and discharges into the valley of Poker Creek. The source of the groundwater is unknown, but appears to be an aquifer in the south-facing, non-permafrost side of Caribou Peak that is intersected by the north-south striking fractures. These fractures then transmit the water to the northern face and channel it through the permanently frozen layer beneath this side. In addition to identifying these unfrozen, localized groundwater flows within perennially frozen bedrock, the radar profiles also revealed signatures that suggest a transition in unfrozen water content within the marginally frozen colluvium.

CR 91-18 ANALYSIS OF RIVER ICE MOTION NEAR A BREAKING FRONT.

Ferrick, M.G., Weyrick, P.B., Hunnewell, S.T., Oct. 1991, 17p., ADA-243 431, 9 refs.

46-1871
RIVER ICE, ICE BREAKUP, VELOCITY
A quantitative theory of dynamic river ice breakup is not yet available. One of the essential components of such a theory is a description of the ice motion near the breaking front. In this report the authors develop an analysis of this motion for a specific case that is consistent with observed data. The analysis is generalized by allowing the speed of the breaking front to vary, and the parameters of the ice motion that are obtained represent different dynamic breakup behaviors that have been described previously. The results of the analysis include 1) the hydraulic radius associated with the ice cover and the total ice acceleration as functions of time, 2) the equilibrium ice velocity as a function of bank resistance, and the ice velocity as a function of time for several initial and bank resistance conditions, 3) the time-varying bank resistance at the measurement location, and 4) the time of ice motion, ice velocity, ice acceleration, and the convergence of the moving ice with distance from the breaking front. The measure of ice convergence quantifies the loss of surface area by the sheet that is required for ice continuity, and distinguishes the types of dynamic breakup.

CR 91-19 ROLE OF THERMAL CONVECTION IN HEAT AND MASS TRANSPORT IN THE SUBARCTIC SNOW COVER.

Sturm, M., Oct. 1991, 82p., ADA-243 674, Refs. p.67-72. For Ph.D. thesis of same title see 45-505.

46-1872
METAMORPHISM (SNOW), AIR FLOW, CONVECTION, DEPTH HOAR, SNOW COVER, THERMAL CONDUCTIVITY, WATER VAPOR, VAPOR TRANSFER, HEAT TRANSFER, MASS TRANSFER

The purpose of this study was to investigate the role of air convection in moving heat and water vapor in snow. To detect convection, the three-dimensional temperature field in the Fairbanks snow cover was measured hourly three winters (1984-1987). Measurements of snow density, compaction, and grain size were made monthly to determine the water vapor flux and textural changes. The snow metamorphosed into depth hoar, producing a sequence of five layers, including a basal layer with horizontal c-axes. C-axes in the overlying layers were vertical or randomly oriented. As the depth hoar developed, its air permeability increased to a value several times higher than previously measured for any snow, while the number of snow grains per

unit volume decreased by an order of magnitude as a few select grains grew while others sublimated away. Simultaneously, there was a net transfer of mass from the base to the top of the snow due to mass flux gradients that averaged .000003 kg/m²/s/m, but were occasionally 10 times higher. Convection occurred sporadically in the winter of 1984-85 and continuously in the winters of 1985-86 and 1986-87. The evidence was 1) simultaneous warming and cooling at different locations in a horizontal plane in the snow, and 2) horizontal temperature gradients of up to 16 C/m. The convection was time-dependent, with perturbations such as high wind or rapid changes in air temperature triggering periods when horizontal temperature gradients were strongest, suggesting these were also periods when the air flow was fastest. During the winter, warm and cold zones developed in the snow and remained relatively fixed in space. The zones were probably the result of a diffuse plume-like convection pattern linked to spatial variations in the temperature of the snow/soil interface. Air flow was inferred to have been horizontal near the base of the snow and vertical elsewhere. Flow averaged 0.2 mm/s, with a maximum of 2 mm/s. During average flow conditions, convection moved about a third of the total heat, but did not move significant mass. However, the coincidence of crystals with horizontal c-axes and the horizontal flow lines at the base of the snow suggest that convection may have affected crystal growth direction.

CR 91-20 ENERGY ABSORPTION OF GRAPHITE/ EPOXY PLATES USING HOPKINSON BAR IMPACT.

Dutta, P.K., Hui, D., Altamirano, M.R., Oct. 1991, 18p., ADA-244 256, 13 refs.
46-1873

VELOCITY, COMPOSITE MATERIALS, LOW TEMPERATURE TESTS, DAMAGE, WAVE PROPAGATION, TEMPERATURE EFFECTS

This work summarizes the analytical and experimental study on the energy absorption of quasi-isotropic graphite/epoxy composite plates due to the impacting hemispherical penetrator in a Hopkinson bar apparatus. The mechanics of stress wave propagation through the bar and the composite laminate plate are discussed to predict the phenomenological process involved. The experimental data provided the results in terms of force, velocity, and energy of impact at all times during the penetration process occurring in microseconds. It has been concluded that loss of contact occurs frequently during the penetration process due to the stress wave reflections back and forth in the thickness direction. The damage process seemed to be both velocity and temperature dependent. Below a certain transition velocity the laminate absorbs less energy at low temperature than at high temperature. The reverse is true above this transition velocity. The mechanism of failure tends to change with impact velocity in such a way that progressively less energy is absorbed at higher velocities.

CR 91-21 CONSTRUCTION GUIDELINES FOR OIL AND GAS EXPLORATION IN NORTHERN ALASKA.

Crory, F.E., Nov. 1991, 83p., Refs. p.81-83.
46-2563

DESIGN CRITERIA, TUNDRA, PERMAFROST, ENVIRONMENTAL IMPACT, ICE RUNWAYS, COLD WEATHER CONSTRUCTION, SNOW ROADS, COLD WEATHER OPERATION, AIRCRAFT LANDING AREAS, PETROLEUM INDUSTRY, GAS PRODUCTION

This report addresses the unique problems associated with oil and gas explorations in northern Alaska and provides background information on the climate and environment, including the permanently frozen ground that exists throughout the area. Information on exploration efforts in the 1940s and 1950s is also included to demonstrate what happens when summertime operations disturb the surface vegetation and thermal regime of the frozen tundra; this is the reason why such operations are no longer permitted. Separate chapters are provided on the design, construction and operation of winter trails, roads, airfields and drill pads, including a separate chapter on their abandonment. Emphasis is placed on how, why and when to perform the various tasks to successfully accomplish an exploration.

CR 91-22 SUBSURFACE DRAINAGE OF PAVEMENT STRUCTURES: CURRENT CORPS OF ENGINEERS AND INDUSTRY PRACTICE.

Allen, W.L., Dec. 1991, 31p., ADA-245 898, 44 refs.
47-3339

SUBSURFACE DRAINAGE, PAVEMENT BASES, ROADS, FREEZE THAW CYCLES, ICE LENSES, DESIGN, SEEPAGE, SURFACE DRAINAGE, PERMEABILITY
Drainage of pavement structures is recognized as a key factor in improving the performance and extending the maintenance-free life of pavement systems. The use of pavement drainage structures to remove water introduced to the pavement system by surface infiltration, melting of ice lenses formed during freeze-thaw cycles, and groundwater sources has become more prevalent during the last decade. The components that make up a well-drained pavement section are commonly known: adequate surface drainage, permeable base courses, filters and a system of collector pipes. However, the details of the design of these components change with the agency constructing the pavement and the use of the pavement. The criteria and specifications of Federal and State governments, and private industry, along with those currently used by the Corps of Engineers, will be presented in this document. A comparison of the practices

used in designing pavement drainage systems, among agencies, is presented to show where some design practices may benefit from technologies already accepted by others.

CR 91-23 DETERMINING THE INTRINSIC PERMEABILITY OF FRAZIL ICE. PART 1. LABORATORY INVESTIGATIONS.

White, K.D., Dec. 1991, 15p., ADA-248 325, 17 refs.
46-3037

FRAZIL ICE, PERMEABILITY, RIVER ICE, ICE MECHANICS, LABORATORY TECHNIQUES

The intrinsic permeability of frazil ice describes the capacity for flow through the ice matrix and can be used to estimate the porosity of the deposit. There are no existing in-situ tests for determining the intrinsic permeability of a frazil ice deposit. The borehole dilution test, an in-situ, relatively nondestructive test often used in soils testing, was modified for use in frazil ice. In this test the dilution of a dye tracer introduced into a borehole made in a laboratory frazil ice deposit was measured over time. The test results were used to find the seepage velocity through the frazil deposit, from which the intrinsic permeability is calculated using the Dupuit-Forchheimer approximation to flow between two reservoirs. The results from the laboratory experiments indicate that the test may be modified for use as an in-situ method to determine intrinsic permeability in frazil ice deposits.

CR 92-01 VECTOR ANALYSIS OF ICE FABRIC DATA.

Ferrick, M.G., Claffey, K.J., Mar. 1992, 17p., ADA-250 832, 20 refs.
46-4000

SEA ICE, ANALYSIS (MATHEMATICS), ICE MECHANICS, ICE CRYSTALS, ORIENTATION

The mechanical properties of ice are strongly affected by crystal texture and c-axis alignment. In this report a general quantitative method for analysis of uniaxial crystal orientation data was developed. These data are represented as unit vectors from the origin with endpoints on the surface of a unit sphere. An orthogonal least-squares error measure is used to develop equations that define the closest plane and line through the data. The resulting eigenvalue problem is identical to that obtained by other investigators using different methods. However, an implicit assumption in the method was identified, and it was observed that the error measure represents physical distance and quantifies the goodness-of-fit of the idealized structures to the data. For comparison, a parallel development is presented of classical dependent-variable least squares. A method is developed to transform the data and the results for viewing on Schmidt nets drawn in the best plane and the predominant basal plane of a sample, in addition to the standard xy-plane. Applications of the analysis to sea ice samples include both numerical and Schmidt net presentations of results.

CR 92-02 AIR TIGHTNESS MEASUREMENT TECHNIQUE FOR MULTIPLEX HOUSING.

Flanders, S.N., Mar. 1992, 11p., ADA-250 831, 5 refs.
46-4003

AIR FLOW, BUILDINGS, HOUSES, MEASUREMENT

This report develops means to evaluate the air tightness of multiple-residence buildings using fan pressurization apparatuses. The fan pressurization apparatuses are mounted in the doors of adjacent attached dwellings, either to equalize pressures between dwellings or to coordinate a pressure difference. Equalization of pressures between adjacent zones permits evaluation of the exterior envelope tightness. Coordination of pressures between adjacent zones permits evaluation of the tightness of party walls or floors. The report discusses the sampling requirements necessary to achieve adequate precision for calculating an equivalent leakage area, *L*, from each mode of pressurization. Several field studies of multiple-residence buildings at Fort Drum, NY, provided an opportunity to test the principles described in this paper. The buildings measured often had very consistent values of *L* per unit of envelope area or party wall or roof area within a neighborhood constructed by the same contractor. Confidence limits obtained for calculating *L* gave a 95% chance of being within bounds determined by the following factors: 1) zone difference measurements had an upper limit of 1.1 or a lower limit of 1/1.1; and 2) pressure difference measurements across a party wall or floor had an upper limit of 1.4 to 5.5 or a lower limit of 1/1.4 or 1/5.5.

CR 92-03 SLOW GROWTH OF ICE CRYSTALS IN WATER.

Colbeck, S.C., Mar. 1992, 10p., ADA-251 864, 12 refs.
46-4371

ICE CRYSTAL STRUCTURE, ICE CRYSTAL GROWTH, FRAZIL ICE, SLUSH

Ice crystals were slowly grown in supercooled water at growth rates spanning those for slush to those for frazil. All of the crystals were disks with aspect ratios between 2 and 35, which increased with growth rate. The growth rates were much less than expected from theory, possibly because of crowding in the experiment. The shapes showed a gradual transition from well-rounded to highly-faceted as the growth rate increased. Even in the lower range of growth rates the crystals do not undergo metamorphism during growth, so the kinetics of crystal growth controls the shape over the entire range of

growth rates investigated here. This explains why all of the crystals were disk shaped, as opposed to the well-rounded crystals seen in slush.

CR 92-04 MODEL FOR VERTICAL FRAZIL DISTRIBUTION.

Liou, C.P., Ferrick, M.G., Apr. 1992, 14p., ADA-251 519, 30 refs.
46-4054

RIVER ICE, FRAZIL ICE, TURBULENT FLOW, MATHEMATICAL MODELS

A model is presented for the evolution of frazil over depth and with time in a turbulent flow. The net upward migration due to buoyancy of the frazil is opposed by intermittent mixing induced by large energy-containing eddies. A surface renewal model is used to describe the effects of large eddy mixing. Parameters that represent an entire water body are obtained by averaging those of discrete water columns using a probability density function. These parameters include the concentration profile, the surface age, and the surface layer thickness. A dimensionless surface renewal frequency characterizes the frazil distribution at equilibrium. The rate of heat loss from the water surface, the surface renewal frequency, and the critical surface layer thickness determine whether the frazil will evolve toward a well-mixed equilibrium state or a layered state. The model provides a physical basis for understanding the transition between these states, consistent with existing empirical criteria and field data.

CR 92-05 WATERFOWL MORTALITY IN EAGLE RIVER FLATS, ALASKA: THE ROLE OF MUNITIONS RESIDUES.

Racine, C.H., Walsh, M.E., Collins, C.M., Calkins, D.J., Roebuck, B.D., Reitsma, L., May 1992, 37p., ADA-252 646, 35 refs.
46-4462

MILITARY OPERATION, ENVIRONMENTAL IMPACT, ANIMALS, PHYSIOLOGICAL EFFECTS

The death of hundreds of migrating dabbling ducks and 10-50 swans has been documented annually for the last ten years in Eagle River Flats (ERF), an estuarine salt marsh on Ft. Richardson, AK. This marsh has been used for the past 40 years as an artillery impact range by the U.S. Army. During May and Aug. 1990, CRREL collected 250 sediment and water samples and analyzed them for munitions residues. The authors found 2,4-DNT in a limited area of Eagle River Flats not used by waterfowl, and white phosphorus in sediments from the bottom of shallow ponds where waterfowl feed. Tissues from waterfowl observed to die or found dead in the salt marsh were collected, and white phosphorus was found in the gizzards of all 11 carcasses collected in Eagle River Flats. Adult mallards dosed in the laboratory with white phosphorus showed identical behavioral symptoms to those of wild ducks observed to become sick and die in Eagle River Flats. All evidence indicates that white phosphorus, as a particulate in the sediments, is responsible for the death of waterfowl in Eagle River Flats. Since the bottom sediments of the shallow salt marsh ponds are anaerobic, the white phosphorus particles will persist in the sediments indefinitely and remain a threat to waterfowl.

CR 92-06 AQUEOUS EXTRACTION-HEADSPACE/GAS CHROMATOGRAPHIC METHOD FOR DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN SOILS.

Hewitt, A.D., Miyares, P.H., Leggett, D.C., Jenkins, T.F., Apr. 1992, 14p., ADA-253 124, 27 refs.
46-5148

SOIL POLLUTION, ENVIRONMENTAL IMPACT

This study compares aqueous extraction-headspace/GC Chromatography (GC) and the EPA SW-846 purge-and-trap-gas chromatography/mass spectrometry (Method 8240) for the determination of four common Volatile Organic Compounds (VOCs) in soils. Comparisons were made on two fortified soils and two contaminated field soils. In only two of the cases were consistent significant differences found—for the two most hydrophobic compounds in a high organic carbon soil, and for TCE in a field-contaminated soil that had previously shown slow aqueous VOC desorption. The findings strongly suggest that aqueous extraction-headspace/GC can be used not only to screen soils for VOCs giving same-day results, but often will provide results not significantly different from current laboratory based measurements.

CR 92-07 DETERMINING THE INTRINSIC PERMEABILITY OF FRAZIL ICE. PART 2: FIELD INVESTIGATIONS.

White, K.D., Lawson, D.E., May 1992, 15p., ADA-255 410, 20 refs.
47-695

FRAZIL ICE, PERMEABILITY, BOREHOLES, SEEPAGE, POROSITY

The intrinsic permeability of a frazil deposit can be used to describe its flow capacity and structure. Because of the nature of frazil ice, an *in-situ* test is desirable when determining this parameter in natural frazil deposits. This report describes the application of the borehole dilution test to determine seepage velocity, which is then used to calculate intrinsic permeability and estimate porosity. Seepage velocity

ties ranged from .00029 to .00598 cm/s (.00256 cm/s average), with an average intrinsic permeability of .000275 sq cm. Porosities for d10 grain sizes of 0.5 and 3.5 were 82.9 and 47.5%, respectively. Seepage velocity and porosity data are also compared to laboratory data from borehole dilution tests, data measured previously at the same location with an *in-situ* groundwater flow meter, and to permeameter test results on remolded samples.

CR 92-08 SUB-BOTTOM SURVEYING IN LAKES WITH GROUND-PENETRATING RADAR.

Sellmann, P.V., Delaney, A.J., Arcone, S.A., May 1992, 18p., ADA-252 860, 17 refs.
46-5146

ANTENNAS, RADAR, UNDERWATER ACOUSTICS, LAKES, SOUNDING

Short-pulse radar was used on lakes in New Hampshire for sub-bottom surveying. The objectives were to construct a low-frequency, high-powered antenna suited for this application, and to evaluate the technique under a range of sub-bottom conditions. A compact 50-MHz antenna with a hydrodynamic housing was fabricated for this study. The transmitter provided a peak input power of approximately 1000 W and noise was decreased by submerging the separated antennas on each side of a fiberglass boat to assure consistent coupling. A 100-MHz commercial antenna unit placed in the bottom of the boat and a 7-kHz acoustic sounder, both of which had vertical resolution theoretically comparable or superior to that of the 50-MHz radar, and theoretical studies of antenna directivity were used to help evaluate the results. In shallow water of 1-2 m depth, estimates of the thickness of low density organic sediments (1-4 m thick) over more dense bed material were obtained at both radar frequencies. Noticeable apparent sedimentary bedding and layering, various sediment types and variations in the depth to bedrock beneath the bed were obtained in low-conductivity lake water more than 20 m deep with the higher powered 50-MHz system. Maximum bed penetration was at least 7 m in these cases, and vertical bedding resolution was far superior to the acoustic results. Radar bathymetry and limited sub-bottom data were obtained in water up to 30 m deep.

CR 92-09 PERFORMANCE OF INSULATED PAVEMENTS AT NEWTON FIELD, JACKMAN, MAINE.

Kestler, M.A., Berg, R.L., May 1992, 24p., ADA-254 017, 10 refs.
46-5147

FROST PENETRATION, INSULATION, FROST HEAVE, CONCRETE PAVEMENTS, COLD WEATHER PERFOR- MANCE

In 1986 the runway at Newton Field, a small airport in Jackman, ME, was reconstructed using a 2 in.-thick layer of extruded polystyrene insulation as part of the pavement structure. At the same time, a nearby town road was reconstructed using a conventional noninsulated pavement cross section for relatively heavy loads. Both pavements were monitored for frost penetration, frost heave, and seasonal changes in pavement strength. Since frost penetration beneath the insulation layer of the runway at Newton Field exceeded empirical estimates during winter 1986-1987, four additional test sections with varying combinations of insulation and subbase thicknesses were constructed adjacent to the airport's parking apron during summer 1987. Although the thermal performance of the insulated pavement test sections was comparable to design expectations for the following 3 years, evidence of discontinuities in the insulation layer in the Newton Field runway demonstrates the insulated pavement's susceptibility to variations in construction technique and site conditions. This report discusses pavement performance at each of the test sites over the observation periods 1986-1990 and 1987-1990.

CR 92-10 WINTER AND TRANSITIONAL ENVIRONMEN- TAL EFFECTS ON THE RELIABILITY OF EXTERIOR INTRUSION DETECTION SYS- TEMS.

Peck, L., May 1992, 44p.
49-387

DETECTION, SENSORS, ACCURACY, COLD WEATHER OPERATION, SNOW COVER EFFECT, TEMPERATURE EFFECTS, FROZEN GROUND

Environmentally induced changes in the detection capability of several commercially available intrusion detection systems (IDSs) were determined through long-term monitoring and controlled intrusions during Nov. 1990-Apr. 1991 and June-July 1991. The suite of IDSs included passive infrared, ported coaxial cable, microwave, vertical taut wire and fence vibration systems. Probabilities of detection and nuisance alarm occurrences were determined for conditions of unfrozen and frozen ground; snow depth of 0-27 cm; air temperatures of -25 to 30 C; and rain and snow storms. For selected IDSs, sensor/environment interaction was directly monitored.

CR 92-11 ANALYSIS OF A PASSIVE INFRARED PERIME- TER SECURITY SYSTEM.

Lacombe, J., Peck, L., June 1992, 32p., ADB-166 114, 11 refs.
46-5317

DETECTION, THERMAL RADIATION, THERMAL ANAL- YSIS, SENSORS

An assessment has been made of the capabilities of a passive infrared

intrusion detection sensor (PIR). The study involved a series of field tests and the development of a sensor model. The field tests were conducted during the spring of 1991 at the South Royallon Intrusion Detection Systems (SOROIDS) test site in Vermont. These tests documented the ability of two ELTEC Model 862-71C PIRs to detect a heated 0.3 m (1-ft) diameter target as it moved through the surveillance zone of the two sensors. Thermal contrast and speed thresholds required to alarm the sensors were identified from the test data using a binary decision-tree classification process. A simple model has been developed that predicts sensor performance based on target and background temperatures, target dimensions and target speed. Results from analyses of the heated target test data appear to verify its accuracy. The model has been exercised for a variety of input conditions to demonstrate its general utility. Limitations of the model have been identified and tasks proposed to improve its accuracy, extend its use for slow-moving targets (i.e., speeds less than 0.5 m/s), and incorporate the effects of natural obscuration. By linking this model to surface temperature thermal algorithms, it should be possible to predict thermal contrast (and sensor performances) based on environmental inputs.

CR 92-12 SHOCK RESPONSE OF SNOW: ANALYSIS OF EXPERIMENTAL METHODS AND CONSTITU- TIVE MODEL DEVELOPMENT.

Johnson, J.B., Brown, J.A., Gaffney, E.S., Blaisdell, G.L., Solie, D.J., July 1992, 19p., ADA-256 300, 25 refs.
47-705

SNOW MECHANICS, SHOCK WAVES, STRESS STRAIN DIAGRAMS, MODELS

A shock impact test was conducted on snow with an initial density of 400 kg/cu m using a large-diameter gas gun and Lagrangian stress gauges between layers of snow. The shock propagation velocity ranged from 240 to 207 m/sec, the peak stresses in the snow were between 20 and 40 MPa, and the compacted snow density was less than 860 kg/cu m. Interpretation of the stress records was complicated by the unsteady nature of the shock, impedance mismatching between gauges and snow, multiply-reflected pulses, and release waves generated at the edge of the target. A dynamic finite-element analysis was used to interpret the data, to construct a constitutive relationship for the snow, and to examine the importance of the release waves. Model calculations indicate two release wave sources: the free edge of the target aluminum buffer and the edge of the snow in contact with the copper container. The aluminum buffer release waves contain both shear and dilatational components. Transmission across the aluminum/snow interface significantly attenuated dilatational waves and essentially eliminated the shear waves. The snow/copper release wave did not arrive at the stress gauge position until after the end of the experiment. With the aid of model calculations, the pressure volumetric-strain (P-V) curve for initial shock loading was determined from arrival time information and stress measurements at the embedded gauges. Stress signals caused by reflected waves were used to determine the reloading and unloading P-V curve. The P-V response for shock loading was found to be much stiffer than that for quasi-static loading. The unloading P-V curves used in model calculations were nonlinear functions of volumetric strain with linear reloading.

CR 92-13 PETROGRAPHIC AND SALINITY CHARAC- TERISTICS OF BRACKISH WATER ICE IN THE BAY OF BOTHNIA.

Gow, A.J., Weeks, W.F., Kosloff, P., Carsey, S., July 1992, 36p., ADA-256 302, 31 refs.
47-706

ICE GROWTH, ICE STRUCTURE, ICE TEMPERATURE, ICE CRYSTALS, ICE SALINITY, FRAZIL ICE, SYN- THETIC APERTURE RADAR, BOTHNIA, BAY

Field observations made during the Mar. 1988 BEPERS (Bothnian Experiment in Preparation for ERS-1) remote sensing experiment included measurements of the snow and ice thickness, temperature, salinity and crystal structure profiles of the different types of brackish ice that form in the Bay of Bothnia. Both undeformed fast ice and ice that had formed under more disturbed conditions were sampled. Ice thickness varied from 36 to 64 cm in the bay to the east of Umeå, Sweden, with somewhat thicker ice (76 cm) occurring in the northernmost, nearly fresh water areas of the Bay of Bothnia. Three major ice crystal types or textures were identified—granular, transition and columnar ice—with the amount of each depending on the level of disturbance in the water column. At seven of the sixteen sites investigated, granular (mainly frazil) ice was the dominant component. At six of the remaining nine sites, columnar-congelation ice was the predominant ice crystal type. A mix of transition and transition-congelation ice types dominated the structure of the remaining three sites. At all but two sites the bottom ice consisted of congelation ice, which in many instances exhibited the ice plate and brine layer substructure so typical of arctic sea ice. A variety of c-axis fabrics were observed in the columnar-congelation ice, including random, vertical and horizontal (planar) orientations. Aligned c-axes were observed at several locations, but in most cases there was no obvious pattern to the geographic arrangement of these fabrics. Surface water salinities ranged from 3.6 to 4.1 per mill except at the northernmost sites near Tornio, where essentially riverine fresh water was present. Bulk salinities ranged from 1.21-0.58 per mill in the area of the main experiment to as low as 0.06 per mill near Tornio. Ice temperatures were usually higher than -3.5 C. Brine volume profiles were used to estimate representative ice property profiles for com-

parison with those of more typical sea ice of similar thicknesses from the Arctic Ocean. A variety of structural factors contributing to specific areas of high and low radar return from ice in the Bay of Bothnia are also discussed.

CR 92-14 EFFECTS OF SEVERE FREEZING PERIODS AND DISCHARGE ON THE FORMATION OF ICE JAMS AT SALMON, IDAHO.

Zufelt, J.E., Bilello, M.A., Aug. 1992, 12p., ADA-255 876, 11 refs.
47-698

FLOOD CONTROL, FLOODING, ICE BOOMS, ICE CONTROL, ICE JAMS, AIR TEMPERATURE, DEGREE DAYS, FREEZEUP, UNITED STATES—IDAHO—SALMON RIVER. Large ice jams on the Salmon River have reached Salmon, ID, and resulted in major flood damage during 16 winters since the winter of 1936-37. Two recent ice jams, in Feb. 1982 and Jan. 1984, caused flooding that resulted in damages of 1 and 1.8 million dollars, respectively. A detailed analysis of the winter air temperature records from 1936-37 through 1991-92 revealed a strong relationship between the duration and intensity of severe cold periods, the air temperature record prior to the severe cold periods, and the occurrence of ice jams reaching the city of Salmon that result in flooding. A threshold condition is identified from which the probability of ice jams reaching the city can be determined from inspection of forecasted air temperatures. It was found that once an ice jam reaches the city, average daily air temperature of approximately 18 deg F are necessary to keep the jam in place. The effects of discharge on ice thickness, and therefore ice jam length, are shown to be minor and no relation could be found in this study. An ice control structure located upstream of the city of Salmon appears to be helping to alleviate ice-jam flooding.

CR 92-15 EFFECTIVENESS AND VARIABILITY OF DIGESTION PROCEDURES FOR ZINC DETER- MINATION IN AGED, CONTAMINATED SOILS.

Reynolds, C.M., Aug. 1992, 13p., ADA-258 454, 35 refs.
47-1897

SOIL POLLUTION, METALS

Owing to the numerous advantages provided by microwave digestions, regulatory agencies are recognizing its value, yet most reported comparisons of microwave digestions with other accepted methods have used ores, laboratory-spiked soils, or soils with unexceptional, rather than elevated, metal concentrations. Objectives of this research included evaluating microwave digestion for routine laboratory use and comparing microwave, block digester, and hot-plate soil digestion techniques for determining zinc in aged, zinc-contaminated soils. Soil samples, chosen to provide a more realistic and rigorous test of the digestion procedures than would spike recovery methods, and known to contain appreciable quantities of zinc, were collected from sites near a zinc smelter that had operated for more than 80 years. To obtain a range of zinc concentrations, surface (0-20 cm) samples of Weikert silt loam soil (loamy-skeletal, mixed, mesic, shallow Typic Dystrachrept) were collected from a location subject to airborne contamination from the smelter site. Very highly significant effects for digestion method, soil, and method x soil interaction were observed. Considering all the soils analyzed as a group, there was no significant difference in zinc release between two separate microwave digestions, or between the hot-plate and block digestion methods. However, microwave digestion resulted in significantly more complete metal release and greater metal concentration values than did either the hot-plate or block digestion methods. Effect of digestion method was not constant among soils. Uniformity for the microwave digestion replications was better than for either block or hot-plate methods. Incomplete digestion and contamination occurred more frequently using hot-plate digestion. For two separate but identical microwave digestion treatments, the average coefficient of variability (CV) values of digestion replication means were 20.5% and 28.7%, respectively. The analogous values for the block digestion and hot-plate methods were 39.2% and 69.5%, respectively. The hot-plate digestion variability was significantly greater than either the block digestion or microwave methods. Microwave digestions provided markedly faster digestion times and often greater zinc release than other methods. Zinc release using microwave digestions was equal to or greater than that using other methods. This study demonstrated that regardless of digestion method, variability within a soil sample presents significant challenges, both in obtaining uniform analytical results and in interpretations.

CR 92-16 LABORATORY INVESTIGATION OF TRASH RACK FREEZEUP BY FRAZIL ICE.

Andersson, A., Daly, S.F., Sep. 1992, 11p., ADA-258 120, 5 refs.
47-1896

FRAZIL ICE, CHANNELS (WATERWAYS), FREEZEUP

A series of tests was conducted in a refrigerated flume facility to determine the ice accumulation pattern on models of water intake trash racks. Data gathered included the flow velocity, the water temperature and the porosity of the accumulated frazil ice (mean porosity is 0.67). Frazil accumulates first on the upstream face of the trash rack bars (being insensitive to bar shape), and then bridges between individual bars near the water surface, proceeding downward until

the entire trash rack is blocked. Flow through the rack became highly nonuniform during the accumulation process.

CR 92-17 COMPARISON OF THAWING SOIL STRENGTH MEASUREMENTS FOR PREDICT- ING VEHICLE PERFORMANCE.

Shoop, S.A., Sep. 1992, 11p., ADA-258 263, 9 refs.
47-1895

SOIL STRENGTH, GROUND THAWING, THAW DEPTH,
SOIL WATER, SHEAR STRENGTH, SHEAR STRESS,
FREEZE THAW TESTS, VEHICLES, COLD WEATHER
PERFORMANCE

The CRREL Instrumented Vehicle (CIV), shear annulus, direct shear, and triaxial compression devices were used to characterize the strength of thawed and thawing soil. These strength values can be used in simple traction models to predict the tractive performance of vehicles. Strength was evaluated in terms of the parameters of cohesion and internal angle of friction based on the Mohr-Coulomb failure criterion. It is proposed here that an instrumented vehicle is best suited for terrain characterization for mobility studies because the conditions created by a tire slipping on a soil surface are exactly duplicated. The cohesion and internal angle of friction values from the shear annulus were found to overpredict traction because of the low normal stress applied by the annulus and the curved nature of the failure envelope. Of all the tests, the direct shear test yielded the highest internal angle of friction value, most likely because the test was run at a slow deformation rate under drained conditions. The triaxial test results were the most similar to those from the vehicle. All test methods show internal angle of friction increasing with soil moisture up to the liquid limit of the soil, and then decreasing. As measured with the vehicle, internal angle of friction was also found to be strongly influenced by the thaw depth.

CR 92-18 STATE-OF-THE-ART SURVEY OF FLEXIBLE PAVEMENT CRACK SEALING PROCEDURES IN THE UNITED STATES.

Eaton, R.A., Ashcraft, J., Sep. 1992, 19p., ADA-258 050, 11 refs.
47-707

CONCRETE PAVEMENTS, CRACKS, SEALING, COLD
WEATHER OPERATION, MEETINGS

A survey of all 50 United States was conducted in September of 1990 to determine the state of the art of crack sealing procedures on flexible asphalt concrete pavements. The results were tabulated and a summary report prepared. A meeting was held at the U.S. Army Cold Regions Research and Engineering Laboratory to discuss the draft report; the comments and suggestions received were incorporated into this report. At the meeting the group identified the need for a trade organization to develop uniform specifications and terminology and to promote proper equipment, methodology, materials, training and education in the pavement crack sealing industry.

CR 92-19 DESIGN AND ANALYSIS OF A LOW SPEED DRAG PLOW FOR USE IN DEEP SNOW.

Walsh, M.R., Richmond, P.W., Sep. 1992, 51p., ADA-258 858, 15 refs.
47-1894

SNOW REMOVAL, EQUIPMENT, DESIGN, COLD
WEATHER PERFORMANCE

Winter logistical operations employing wheeled vehicles are severely restricted because of traction losses in deep snow. To enable the use of wheeled vehicles for off-road winter deployment, an independent drag-plow was developed to be attached to the pintle mount of the U.S. Army's small unit support vehicle (SUSV). Small-scale testing revealed significant stability problems with a towed wedge-shaped plow model. Geometric modifications to the plow design and a 4-bar parallel motion towing linkage were developed to stabilize plow roll and pitch, respectively. A welded aluminum half-width model incorporating these modifications was successfully tested at Keweenaw Research Center in northern Michigan in Jan., 1991. Parameters measured during testing included pitch and roll angles, drawbar forces, speed, plowed geometry, and snow characteristics. These parameters were used to determine the feasibility of a full-scale model capable of plowing a 2.45 m path in 1 m-deep low density snow, leaving 15 cm of snow as ground cover. The model performed well in medium density snow, with drawbar forces in the 5.6-kN range. Plow penetration was limited by a geometric constant of the 4-bar linkage, with 15 deg the approximate maximum link angle from horizontal. Pitch and roll stability in off-road applications was excellent, with the plow demonstrating an ability to right itself and dig in after encountering obstacles. Successful half-width tests have proven the concept of utilizing a SUSV-towed V-plow for clearing access roads in deep snow for off-road winter operations. Data extrapolation of half-width tests demonstrates that a full-scale plow is feasible.

CR 92-20 AIRBORNE MILLIMETER-WAVE FM-CW RADAR FOR THICKNESS PROFILING OF FRESHWATER ICE.

Yankielun, N.E., Nov. 1992, 77p., ADA-259 368, 68 refs.
47-1893

ICE COVER THICKNESS, AIRBORNE RADAR, ELECTRO-

MAGNETIC PROSPECTING, LAKE ICE, RIVER ICE

The ability to profile rapidly and accurately the structure of freshwater ice down to a thickness of a few centimeters over large surfaces of frozen ponds, lakes and rivers has wide military, industrial, commercial and recreational application, including safety and trafficability surveys. A prototype broadband millimeter wave (26.5 to 40 GHz) FM-CW radar, employing real-time data acquisition and digital signal processing techniques, has been developed for continuously recording the thickness profile of freshwater ice. Thickness resolution is better than 3 cm +/- 10%, which improves on short-pulse and FM-CW radars operating at frequencies less than 10 GHz. These other radars have a best reported thickness resolution of approximately 10 cm with a +/- 10% accuracy; this is insufficient because a freshwater ice sheet as thin as 5 cm, floating on water, can be safely traversed by an individual of average weight. System specifications include a 15-dBm output RF power level, a 0.066-second sweep rate and less than a 50-dB signal-to-noise-ratio. This radar was tested on the ground and from a helicopter at heights of up to 7 m above ice surfaces at speeds up to 40 km/hr. Pond and river ice sheets between 3 and 35 cm thick, with and without fresh snow cover, and with minimal surface roughness have been profiled. Results have shown direct correlation between radar and borehole thickness measurements. Losses from volume scattering by imbedded air bubbles did not significantly affect the system's capability to discern the air/ice and ice/water scattering boundaries.

CR 92-21 OPTIMIZATION OF AN ANALYTICAL METHOD FOR DETERMINING WHITE PHOS- PHORUS IN CONTAMINATED SEDIMENTS.

Taylor, S., Walsh, M.E., Dec. 1992, 13p., ADA-261 333, 1 ref.
47-2755

LABORATORY TECHNIQUES, SEDIMENTS, SOIL POLLU-
TION, MILITARY OPERATION

An analytical method was optimized to determine the concentration of white phosphorus (WP) in sediments contaminated by smoke munitions. The method uses isocane as the extractant and a gas chromatograph as the determinative instrument. Both field-contaminated samples and spiked sediments were analyzed and results on the spiked samples indicate that the method has a better than 80% recovery rate for WP. The detection limit for the method is 0.88 microg/kg of soil. The WP recovery is sensitive to the water content of the sediments and to prolonged shaking. Fluidizing the wet sediments by adding water to saturated soil greatly increases WP recovery. Since field samples are contaminated with WP particles of various sizes, subsamples may not accurately represent the concentration of the sample as a whole.

CR 92-22 NUMERICAL SIMULATION OF SYSTEMS OF MULTITUDINOUS POLYGONAL BLOCKS.

Hopkins, M.A., Dec. 1992, 69p., ADA-262 556, 16 refs.
47-2923

ICE MECHANICS, PRESSURE RIDGES, ICE PRESSURE,
COMPUTERIZED SIMULATION, ICE MODELS

CR 92-23 SHIP SUPERSTRUCTURE ICING: DATA COL- LECTION AND INSTRUMENT PERFOR- MANCE ON USCGC MIDGETT RESEARCH CRUISE.

Ryerson, C.C., Longo, P.D., Dec. 1992, 133p., ADA-262 557, 30 refs.
47-2924

SHIP ICING, SEA SPRAY, ICE MODELS, ACCURACY,
DATA PROCESSING, BERING SEA

Spray generated by the collision of a ship's bow with waves freezes on decks, bulkheads and ship's components. It is most common on smaller vessels, where it has been known to cause sinking, typically by capsizing. Superstructure icing may also reduce the operating efficiency or mission performance of larger vessels. The ability to predict the environmental conditions under which icing may occur, the location of icing on a vessel under those conditions, and the rate at which ice will accrete may allow vessels to avoid hazardous conditions or operate in a manner so as to minimize the accretion of ice. This report describes how spray delivery and superstructure icing were measured during a research cruise on the U.S. Coast Guard Cutter *Midgett*, operating in the Gulf of Alaska and Bering Sea in Feb.-Mar. 1990, to support the validation and calibration of a numerically based icing prediction model being developed for the U.S. Navy. This research cruise represents the first such measurements on a vessel significantly larger than fishing trawlers, the basis for prior work. Development of the instrumentation, its placement on the *Midgett*, and ancillary equipment used to supplement the principal measurements are discussed. Data collection and problems encountered in the process are covered extensively. Finally, measurement error is discussed, with conclusions drawn concerning corrections to the data and their validity.

CR 93-01 DEVELOPMENT OF AN AIRBORNE MMW FM- CW RADAR FOR MAPPING RIVER ICE.

Yankielun, N.E., Ferrick, M.G., Weyrick, P.B., Jan. 1993, 10p., 17 refs.
47-2757

RIVER ICE, REMOTE SENSING, AIRBORNE RADAR, ICE
COVER THICKNESS, MAPPING, ICE SPECTROSCOPY

Analyses of a river's freezeup ice cover stability and its breakup rely on detailed knowledge of the cover's thickness and the variability of that thickness. A high-resolution millimeter wave (26.5- to 40 GHz) Frequency Modulated-Continuous Wave radar with real-time data acquisition and digital signal processing and display capability was deployed from a low-flying (3-10 cm) helicopter to continuously acquire, process and display data during an ice thickness profiling survey of a 24 km study reach. A nominal sheet ice thickness of 50 cm, occasional areas of new ice sheet as thin as 5 cm, open leads, and massive ice accumulations of the order of 5 m thick were encountered. Radar profiling data agreed with ground truth from borehole measurements of the sheet ice, and provided a more detailed view of the ice conditions than that obtained from a low altitude video survey. The radar system provided rapid, safe and accurate data acquisition, allowing detailed mapping of the ice conditions throughout the reach.

CR 93-02 MATHEMATICAL MODEL OF FROST HEAVE AND THAW SETTLEMENT IN PAVEMENTS.

Guymon, G.L., Berg, R.L., Hromadka, T.V., April 1993, 126p., ADA-267 037, Refs. p.43-45.
47-4870

MATHEMATICAL MODELS, FROST HEAVE, GROUND
THAWING, SOIL FREEZING, PAVEMENTS, THAW WEAK-
ENING, FROST PENETRATION, HEAT TRANSFER, MOIS-
TURE TRANSFER

Since 1975 the U.S. Army Corps of Engineers, the Federal Highway Administration and the Federal Aviation Administration have been working cooperatively to develop a mathematical model to estimate frost heave and thaw weakening under various environmental conditions and for various pavement designs. A model has been developed. It is a one-dimensional representation of vertical heat and moisture flux, and is based on a numerical solution technique termed the nodal domain integration method; it estimates frost heave and frost penetration reasonably well for a variety of situations. The model is now ready for additional field evaluation and implementation in appropriate cases. The main objectives of this report are to describe the model, FROST, including modeling uncertainties and errors; to summarize recent comparisons between measured and computed values for frost heave and frost penetration; and to describe parameters necessary for input into the model.

CR 93-03 FLOW REGULATION FOR CONTROLLED RIVER-ICE FORMATION.

Jain, S.C., Ettema, R., Park, I., May 1993, 50p.,
ADA-266 409, 38 refs.
47-4662

FRAZIL ICE, RIVER FLOW, RIVER ICE, WATER TEMPER-
ATURE, SIMULATION, FLOW CONTROL, ICE JAMS,
CHANNELS (WATERWAYS), UNITED STATES—OHIO
RIVER

Results are presented of a study to determine appropriate methods of flow modification for mitigating ice jam formation in navigable rivers. Based on a review of alternative methods for flow modification, it is concluded that for many rivers, especially large ones, the most appropriate method involves controlled ice-cover formation through the regulation of river flow. Flow discharge and stages would be regulated by controlling the flow releases from reservoirs and flow stages at river dams, such that optimal flow conditions prevail for rapid formation, and subsequent maintenance, of an accumulation ice cover over river reaches in which potentially large amounts of frazil ice may grow. Accumulation covers would be formed of frazil ice pans and floes and, if appropriate, broken ice conveyed from upstream. Existing dams, augmented where needed by navigable ice booms, could serve as retention structures for the development of accumulation covers. A preliminary indication of the feasibility of this method for controlling ice-cover formation on stage-regulated pools of the Ohio River is assessed through the use of a numerical model that simulates ice-cover formation from frazil ice. This approach holds promise for mitigating jam occurrence, although its implementation necessarily entails management of flow through major portions of the Ohio River. The results of the study are, to a limited extent, generalized to other rivers.

CR 93-04 MATHEMATICAL MODEL FOR RIVER ICE PROCESSES.

Lal, A.M.W., Shen, H.T., May 1993, 80p., ADA-266 847, Refs. p.71-75.
47-4871

MATHEMATICAL MODELS, RIVER ICE, ICE COVER,
UNITED STATES—OHIO RIVER, CANADA—QUEBEC—
ST. LAWRENCE RIVER

River ice processes are complex phenomena that are affected by many factors, including meteorological conditions, thermal inputs, hydraulic conditions and channel geometry. In this study a one-dimensional model called RICE is developed for simulating ice pro-

cesses in rivers. In the river hydraulics component, the flow condition is determined by an implicit finite-difference solution of one-dimensional unsteady flow equations. In the thermal component, distributions of water temperature and ice concentration are determined by a Lagrangian-Eulerian solution scheme for equations of transport of thermal energy and ice. A two-layer formulation is introduced to model the ice transport. In this formulation the total ice discharge is considered to consist of the surface ice discharge and the discharge of suspended ice distributed over the depth of the flow. The effect of surface ice on ice production, as well as the formation of skim ice and border ice, is included. The dynamic formation and stability of the ice cover is formulated according to existing equilibrium ice jam theories with due consideration of the interaction between ice cover and flow. The undercover ice accumulation is formulated according to the critical velocity criterion. The growth and decay of the ice cover is simulated using a finite-difference formulation applicable to composite ice covers consisting of snow, ice and frazil layers. The model has been applied to the St. Lawrence River and the Ohio River system, with simulated results comparing favorably with field observations. Future improvements on the mathematical model as well as theoretical formulations on various ice processes are discussed.

CR 93-05 EVALUATION OF SW846 METHOD 8330 FOR CHARACTERIZATION OF SITES CONTAMINATED WITH RESIDUES OF HIGH EXPLOSIVES.

Walsh, M.E., Jenkins, T.F., Schnitker, P.S., Elwell, J.W., Stutz, M.H., June 1993, 17p., ADA-268 700, Refs. p.13-17.

49-388

EXPLOSIVES, SOIL POLLUTION, WATER POLLUTION, CHEMICAL ANALYSIS, MILITARY RESEARCH

A large body of analytical results from CRREL and the Missouri River Division Laboratory was used to assess how well EPA SW846 Method 8330 satisfies the Army need for characterization of explosives-contaminated water and soil samples. About 97% of the explosives-contaminated soils contained TNT, RDX and/or, 2,4-DNT, and these were the compounds found at highest concentrations. Environmental transformation products such as TNB, 2-amino- and 4-amino-DNT and 3,5-dinitroaniline (3,5-DNA) were also frequently observed. Explosives-contaminated water samples generally contained RDX, HMX and/or TNT. Transformation products commonly found included TNB, DNB, 2,4- and 2,6-DNT, 3,5-DNA and the two isomers of amino-DNT. Limitations of the primary and confirmatory RP-HPLC methods are discussed.

CR 93-06 TERRAIN CHARACTERIZATION FOR TRAFFICABILITY.

Shoop, S.A., June 1993, 23p., ADA-269 925, Refs. p.20-23.

48-718

TERRAIN IDENTIFICATION, SNOW COVER, SNOW STRENGTH, VEGETATION, TRAFFICABILITY, SOIL TRAFFICABILITY, VEHICLES, TERRAIN

Terrain material characterization is needed to predict off-road vehicle performance, trafficability, and deformation (compaction and rutting) resulting from vehicle passage. This type of information is used by agricultural engineers, foresters, military engineers, the auto and tire industry, and anyone else concerned with off-road, unpaved, or winter mobility. This report appraises the state-of-the-art of terrain (or substrate) characterization techniques for vehicle traction studies. It concentrates on field measurement of strength-related properties for soil, snow, muskeg, and vegetation, but also discusses how these compare with laboratory measurements and the importance of other terrain features (slopes, drainage, and obstacles).

CR 93-07 DYNAMIC STUDY OF COMMON WELL SCREEN MATERIALS.

Hewitt, A.D., July 1993, 15p., ADA-269 656, 15 refs.

48-719

WELL CASINGS, STEELS, POLYMERS, GROUND WATER, WATER CHEMISTRY

This report describes a dynamic study of the effects of well screen materials on the chemistry of groundwater during contact periods that are consistent with compliance sampling. Tests were done by passing TCE-contaminated aquifer water through monitoring well screens held in a special chamber, without significant changes in major water quality parameters. The results indicate that polymeric materials (i.e., rigid polyvinyl chloride and polytetrafluoroethylene) do not influence aqueous metal and TCE concentrations, while stainless steel casings significantly influence aqueous concentrations of Cr, Ni and Fe, especially after developing surface corrosion.

CR 93-08 ELUTION OF IONS FROM MELTING SNOW: CHROMATOGRAPHIC VERSUS METAMORPHIC MECHANISMS.

Cragin, J.H., Hewitt, A.D., Colbeck, S.C., July 1993, 13p., ADA-270 430, 22 refs.

48-1006

MELT WATER, SNOWMELT, METAMORPHISM (SNOW), CHEMICAL ANALYSIS, IONS, SNOW CRYSTAL GROWTH

Columns of natural and laboratory-aged snow grains and frozen water droplets were washed with deionized distilled water and with synthetic precipitation solutions to investigate both snowpack chemical fractionation and preferential ion elution. Concentrations of Cl⁻, NO₃⁻, SO₄²⁻ in sequential fractions of the column's eluate showed no chromatographic effects, indicating that ice crystals do not possess selective affinity for inorganic anions. Consequently, preferential chemical elution previously observed in melting snow is not caused by snow acting as a chromatographic column. Additional column experiments involving elution from frozen solution drops and from aged snow showed that both fractionation and preferential elution were strongly influenced by ion exclusion during the snow crystal growth.

CR 93-09 THREE APPROACHES TO WINTER TRACTION TESTING.

Shoop, S.A., July 1993, 17p., ADA-276 484, 5 refs.

For another version see 48-3105.

48-3489

TRACTION, TIRES, TRAFFICABILITY, TERRAIN, VEHICLE WHEELS, COLD WEATHER PERFORMANCE, ICE COVER EFFECT, SNOW COVER EFFECT

Traction on winter surfaces was measured using three test vehicles, each designed to measure traction for a different purpose: vehicle mobility research (CRREL Instrumented Vehicle), commercial tire testing (Uniroyal-Goodrich traction tester), and airport runway safety (Saab friction tester). The traction measured with each method is comparable, but there are systematic differences due to the effects of the surface material and the test and analysis technique. This comparison serves as the fundamental basis for collaboration between the various traction testing communities and illustrates the need for well documented test procedures and data analysis as a standard for traction testing and evaluation.

CR 93-10 THERMAL STRESS MEASUREMENTS IN ASPHALT CONCRETE.

Janoo, V.C., Bayer, J., Jr., Walsh, M.R., July 1993, 30p., ADA-269 926, Refs. p.29-30.

48-720

BITUMINOUS CONCRETES, CRACKING (FRACTURING), THERMAL STRESSES, PAVEMENTS, COLD WEATHER PERFORMANCE, COLD STRESS, TENSILE PROPERTIES, MEASUREMENT

Asphalt concrete (AC) pavements in cold regions are prone to thermal cracking. There are two theories to explain this. The first one is that at some low temperature, the thermal stress in the pavement structure exceeds the tensile strength of the mixture, usually in the winter. The second is that the AC mixture fails through thermal fatigue that is caused by daily temperature cycling. There are many ways of characterizing AC performance at low temperatures, and this report summarizes the different failure criteria and test methods for doing this. One test method described here that CRREL has developed is a thermal stress test device for measuring thermally induced stresses in the laboratory. The device can be used for monotonic and cyclic loading, while various temperature drop rates can be applied to the specimen. The calibration of the test apparatus, loading pattern and specimen configuration used are described and typical results are presented.

CR 93-11 GAS GUN EXPERIMENTS TO DETERMINE SHOCK WAVE BEHAVIOR IN SNOW: METHODS AND DATA.

Johnson, J.B., Brown, J.A., Gaffney, E.S., Solie, D.J., Sturm, M.A., Blaisdell, G.L., July 1993, 143p., ADA-270 467, 33 refs.

48-1005

SNOW DEFORMATION, SNOW DENSITY, SNOW MECHANICS, ATTENUATION, POROSITY, SHOCK WAVES, WAVE PROPAGATION, STRESS CONCENTRATION

A laboratory study of the behavior of snow under shock wave loading and unloading conditions was conducted using a 200 mm-diameter gas gun to generate loading waves in snow samples with initial densities of 100 to 520 kg/cu m at temperatures of -2 to -23 C. Stress levels were 2 to 40 MPa. The response of snow to shock wave loading was measured as a function of distance from the impact plane using embedded stress gauges. Large impedance differences between snow and the stress gauges produced complex stress histories. A finite element model, along with a simple analytical model of the experiment, was used to interpret the stress histories. Snow deformation was not affected by initial temperature, but was found to be rate dependent. The initial density of the snow determined its pressure-deformation path. The pressure needed to compact snow to a specific final density increases with decreasing initial density. The release moduli increased nonlinearly from 50 MPa at a snow pressure of about 15 MPa to 2700 MPa at a snow pressure of about 40 MPa.

CR 93-12 FOOTPRINT SIZE OF A HELICOPTER-BORNE ELECTROMAGNETIC INDUCTION SOUNDING SYSTEM VERSUS ANTENNA ALTITUDE.

Kovacs, A., Holladay, J.S., Bergeron, C.J., Jr., July 1993, 13p., ADA-270 468, 9 refs.

48-1004

REMOTE SENSING, SEA ICE, ICE COVER THICKNESS, SOUNDING, ELECTROMAGNETIC PROSPECTING

Helicopter-towed electromagnetic induction sounding systems have recently been used for the remote measurement of sea-ice thickness and shallow sea bathymetry. An inherent aspect of this sensing technology is the large area, or footprint, over which an individual sounding is made. This report gives an overview of previous footprint size assessments and presents new footprint size estimates determined from sea ice survey data and analytical calculations. All footprint determinations were found to be in reasonable agreement. For a vertical coaxial coil antenna arrangement the apparent footprint diameter was found to be about 1.25 times the antenna height above the conductive surface, and for a horizontal coplanar coil configuration the ratio is about 3.75 times the antenna height.

CR 93-13 FATE AND EFFECTS OF CRUDE OIL SPILLED ON SUBARCTIC PERMAFROST TERRAIN IN INTERIOR ALASKA: FIFTEEN YEARS LATER.

Collins, C.M., Racine, C.H., Walsh, M.E., Aug. 1993, 20p., ADA-270 030, 31 refs.

48-722

CRUDE OIL, OIL SPILLS, ENVIRONMENTAL IMPACT, FOREST SOILS, ACTIVE LAYER, THAW DEPTH, SOIL MICROBIOLOGY, PERMAFROST, TERRAIN, UNITED STATES—ALASKA

The effects of two large experimental oil spills conducted in the winter and summer of 1976 in the permafrost-underlain black spruce forest of interior Alaska were assessed 15 years after the spills. Effects on the permafrost, as determined from measurements of active layer thaw depths and of the total amount of ground subsidence, were far more pronounced on the winter spill because it had a larger area with oil on the surface. The winter spill also had a more drastic effect on the vegetation. Where the black, asphalt-like oil is present on the surface, black spruce mortality is 100% and there is very little live vegetation cover, except for cottongrass tussocks. Changes in oil chemistry vary with depth; surface samples show signs of microbiological degradation, whereas some subsurface samples taken just above the permafrost show no evidence of degradation and still contain volatiles.

CR 93-14 NOTES ON ANTARCTIC AVIATION.

Mellor, M., Aug. 1993, 145p., ADA-273 018, 16 refs.

48-1622

AIRPLANES, TANKER AIRCRAFT, HELICOPTERS, AIRCRAFT LANDING AREAS, ICE RUNWAYS, TIRES, HISTORY, ANTARCTICA

Antarctic aviation has been evolving for the best part of a century, with regular air operations developing over the past three or four decades. Antarctica is the last continent where aviation still depends almost entirely on expeditionary airfields and "bush flying," but change seems imminent. This report describes the history of aviation in Antarctica, the types and characteristics of existing and proposed airfield facilities, and the characteristics of aircraft suitable for Antarctic use. It now seems possible for Antarctic aviation to become an extension of mainstream international aviation. The basic requirement is a well-distributed network of hard-surface airfields that can be used safely by conventional aircraft, together with good international collaboration. The technical capabilities already exist. (Auth.)

CR 93-15 KINEMATIC MODEL OF RIVER ICE MOTION DURING DYNAMIC BREAKUP.

Ferrick, M.G., Weyrick, P.B., Nelson, D.F., Sep. 1993, 16p., ADA-273 141, 19 refs.

48-1621

RIVER ICE, ICE JAMS, ICE BREAKUP, ICE MODELS, VELOCITY, ICE MECHANICS

A study of the dynamics of ice motion during river breakup is begun by formulating a kinematic model. Ice continuity equations are applied to relate the speeds of a breaking front, convergence front, stoppage front, and release front with the ice discharge and volume per unit surface (unit volume) on either side of each front. Ice velocity data are obtained from measurements with time made during a dynamic breakup at a pair of sites bounding a reach of the Connecticut River. The ice and front motion are simulated through time for this reach, using the kinematic model with the assumptions that accumulation thickness and porosity are uniform, and that changes in the ice conditions and motion occur only at a front. Contrary to the basic assumption of static jam formation, it is found that the accumulation develops while the ice is moving, and that jam formation merely represents the arrest of the motion.

CR 93-16 HIGH-STRAIN-RATE TENSILE BEHAVIOR OF SEDIMENTARY AND IGNEOUS ROCKS AT LOW TEMPERATURES.

Dutta, P.K., Kim, K.S., Oct. 1993, 11p., ADA-275 161, 15 refs.

48-2536
LOW TEMPERATURE RESEARCH, LOW TEMPERATURE TESTS, ENGINEERING, DEFORMATION, FRACTURING, STRESS STRAIN DIAGRAMS, TENSILE PROPERTIES, ROCK MECHANICS

The influence of low temperature on the stress-strain behavior, fracture strength, and energy absorption in the dynamic fracturing of a limestone and a granite was determined by experiments conducted with a special low temperature split-Hopkinson pressure bar in the tensile strain rate regime of 80-100 strains s^{-1} . The tensile strength was determined by diametral compression of disk samples (Brazilian method) at -40 C and 24 C. Diametral strains to failure were monitored with a high-speed digital oscilloscope to observe deformations at microsecond intervals. These data were then compared with the results from room and low temperature quasi-static tests. Results show that the tensile strength and the deformability of these rocks are more sensitive to loading rate than to temperature. The mechanism of failure under dynamic loading by stress waves is significantly different from that under quasi-static loading. Dynamic loading produces multiple fractures, absorbs more energy and, because of the cushion of broken rocks produced under the loading surface, requires higher loads for complete failure. The influence of low temperature on strength and deformability under both static and dynamic loadings is less dramatic. Nevertheless, in all cases the strength increased with decreasing temperatures, possibly because of the immobilization of the interfacial water below the freezing temperature.

CR 93-17 WHITE PHOSPHORUS CONTAMINATION OF SALT MARSH POND SEDIMENTS AT EAGLE RIVER FLATS, ALASKA.

Racine, C.H., et al, Oct. 1993, 62p., ADA-278 088, 50 refs.

48-3792
WETLANDS, ENVIRONMENTAL IMPACT, POLLUTION, MILITARY OPERATION, SEDIMENTS, UNITED STATES—ALASKA—EAGLE RIVER FLATS

In 1990, it was proven that an annual waterfowl dieoff involving thousands of waterfowl at Eagle River Flats (ERF), a 1000-ha estuarine salt marsh at Ft. Richardson, AK, was due to the ingestion of highly toxic particles of white phosphorus (WP) that entered the bottom sediments of shallow ponds as a result of training with white-phosphorus smoke munitions. The anoxic conditions of the bottom sediments preserved the normally highly reactive white phosphorus. In 1991 the extent of white phosphorus contamination in the ponds of Eagle River Flats was delineated and the biological effects of WP contamination was investigated further. Over 360 sediment samples were collected from 6 ponds where ducks were observed to feed and become sick and where carcasses of poisoned waterfowl were found. These ponds cover about 50 ha of the 1000-ha salt marsh. Sediment and tissue samples were analyzed for white phosphorus by gas chromatography. White phosphorus was found in 101 surface sediment samples and in sediment cores to depths of 20 cm. The distribution and highest concentrations of white phosphorus were localized in two of the six feeding pond areas, covering about 15 ha. It is hypothesized that these two areas represent the major source of waterfowl poisoning in ERF. While the locations in ERF where various species of waterfowl become sick showed close correlation with white phosphorus contamination in the sediments, dead waterfowl were also found in uncontaminated areas of ERF. No WP was found in over 300 gizzards of ducks harvested by hunters from various Cook Inlet marshes. Evidence for the transport of white phosphorus up the food chain from prey to predator was obtained in relation to the heavy feeding by bald eagles on WP-containing duck carcasses and in the presence of WP in the tissues of one dead eagle found in ERF. It is predicted that white phosphorus will persist in ERF sediments and continue to poison waterbirds until remedial actions are implemented.

CR 93-18 EFFECTS OF GROUNDWATER SAMPLERS ON WATER QUALITY: A LITERATURE REVIEW.

Parker, L.V., Oct. 1993, 14p., ADA-275 507, 43 refs.

48-2608
GROUND WATER, PUMPS, ACCURACY

This report reviews both field and laboratory studies that test or compare the ability of various types of samplers to deliver representative groundwater samples. Several types of grab samplers, positive displacement devices, and suction-lift devices are evaluated. It was found that most of these devices can, under certain circumstances, alter the chemistry of a groundwater sample. Gas-lift pumps, older types of submersible centrifugal pumps, and suction-lift devices are not recommended when sampling for sensitive constituents such as volatile organics and inorganics that are subject to oxidation/precipitation reactions. Generally, of the devices reviewed in this report, bladder pumps gave the best recovery of these sensitive constituents. However, better performance could be achieved for several devices if better operational guidelines were developed by additional testing. Clearly, further research is warranted. Issues that need to be addressed in future studies include pumping rate, use of flow control

mechanisms, and dedication of samplers.

CR 93-19 ON THE TEMPERATURE DISTRIBUTION NEAR A COLD SURFACE.

Yen, Y.C., Oct. 1993, 21p., ADA-275 162, 28 refs.

48-2537
TEMPERATURE DISTRIBUTION, TEMPERATURE GRADIENTS, SURFACE TEMPERATURE, FROZEN GROUND TEMPERATURE, ICE SURFACE, SNOW SURFACE TEMPERATURE, SNOW COVER EFFECT, ICE COVER EFFECT
Temperature profiles were taken during the 1991-92 season at an experimental site on CRREL's grounds; however, they were rather limited because of the unusual lack of snowfall and the location of the site, which was small and had elevated sides (especially in the direction of the prevailing wind). Nevertheless, some unusual features have been observed for the first time. The profiles show the existence of a double-reversal in temperature structure close to the snow surface when the snow temperature is much lower than its melting point, in contrast to a persistent raised maximum temperature over a melting snowpack. This indicates that the micro-heat transport process is complicated by the presence of a non-isothermal lower boundary. Over frozen or partially frozen ground without snow, and with air temperature either above or below the melting point of ice, a thin, nearly isothermal air layer on the order of 2 to 3 cm thick at varying heights was observed for the first time. With very few exceptions, in general, the temperature decreases as height increases, but the extent is less pronounced over a snow cover (where conditions are nearly isothermal) than over cold ground. On the basis of limited measurements, the overall temperature gradient over the bare ground is about twice that over snow-covered ground.

CR 93-20 ATTENUATION OF OUTDOOR SOUND PROPAGATION LEVELS BY A SNOW COVER.

Albert, D.G., Nov. 1993, 104p., ADA-275 387, Refs. p.90-93.

48-2607
SNOW COVER EFFECT, SNOW ACOUSTICS, ACOUSTICS, ABSORPTION, WAVE PROPAGATION

This report investigates the attenuative effect of snow on sound propagation, and provides quantitative measurements and an accurate model for predicting these effects. Summer and winter experiments were conducted at a site in northern Vermont to investigate the effect of a snow cover on low energy sound propagation in the 5- to 500 Hz frequency band for propagation distances between 1 and 274 m. Pistol shots were used as the source of the acoustic waves, with geophones and microphones serving as the receivers. A comparison of the summer and winter recordings revealed a number of effects caused by the introduction of a 0.25 m thick snow cover. The peak amplitude of the air wave was more strongly attenuated in the winter, corresponding to an order of magnitude difference in the signal levels after 100 m of propagation. The waveforms were also markedly changed, with broadened pulses and greatly enhanced low frequencies appearing in the winter recordings. The pulse broadening and peak amplitude decay rates of the acoustic waveforms were successfully predicted theoretically using a layered rigid porous model of the snow, with an assumed surface effective flow resistivity of 20 kN s/m^4 . Calculations of ground motion induced by the atmospheric sound waves were made using a viscoelastic model of the ground and the wavenumber integration technique. Although soil ground motions were successfully modeled, induced motions in the snow were not, and the model always underpredicted the observed decay rates. An investigation of plane wave transmission from a fluid into a porous solid using Biot's theory shows that the presence of pores in the solid is the most important factor in the acoustic energy loss, not attenuation by transmission to the solid frame, and an explicitly porous model will be necessary to compute correctly the motion induced in the snow.

CR 93-21 GROWTH CONDITION OF AN ICE LAYER IN FREEZING SOILS UNDER APPLIED LOADS: I. EXPERIMENT.

Takeda, K., Nakano, Y., Nov. 1993, 11p., ADA-275 215, 14 refs.

48-2443
FREEZING FRONT, FROZEN GROUND, ICE LENSES, ANALYSIS (MATHEMATICS), SOIL FREEZING, TEMPERATURE GRADIENTS, LOAMS, LOADS (FORCES)

A series of freezing tests on Kanto loam were conducted under various overburden pressures to find the steady growth condition of a segregated ice layer. The steady growth condition was found to be determined by the absolute value of the temperature gradient of the unfrozen part of the soil $\alpha(u)$ near the 0 C isotherm, and that of the frozen part of the soil $\alpha(f)$ near the warmest end of an ice layer under given hydraulic conditions and applied effective pressure σ as follows: $\alpha(u) = A\alpha(f)$, $k_f/k_u > A > S(\sigma)$; where k_f and k_u are the thermal conductivities of the frozen and unfrozen parts, respectively, A is a constant and S is an increasing function of σ . This is the first of a two-part presentation on the subject; the analytical aspects of the study are presented in a second report.

CR 93-22 THERMAL VARIATION IN VEGETATED OR SNOW-COVERED BACKGROUND SCENES

AND ITS EFFECT ON PASSIVE INFRARED SYSTEMS.

Peck, L., Nov. 1993, 15p., ADA-275 174, 17 refs.

48-2535
SENSORS, INFRARED EQUIPMENT, DETECTION, TEMPERATURE VARIATIONS, SNOW COVER EFFECT
The diurnal and seasonal variations in the magnitude of and rate of change of surface temperature have been investigated for vegetated and snow-covered ground under winter, summer and transitional weather conditions at a site in Vermont. The variability in thermal radiance is evident as changes in the proximity-to-alarm status of passive infrared detection systems. A mid-winter snow cover is the most favorable background because its associated thermal radiance changes are less dynamic than are the radiance changes of uniform grass covers in summer or mixed backgrounds of grass-thatch-soil following winter. Grass-thatch-soil backgrounds typically experience a larger diurnal range in temperature (from nighttime low to daytime high) and greater spatial variability in thermal radiance than do the uniform grass covers. The summer grass is more likely to be long enough to blow in the wind, thereby causing a change in thermal radiance as the sun-warmed upper portion of the grass blades or the shaded (and therefore cooler) basal portion of the grass blades, and perhaps the sheltered soil, are momentarily exposed to the passive infrared system.

CR 93-23 PRELIMINARY ASSESSMENT OF SEDIMENTATION AND EROSION IN EAGLE RIVER FLATS, SOUTH-CENTRAL ALASKA.

Lawson, D.E., Brockett, B.E., Dec. 1993, 23p., ADA-276 997, 27 refs.

48-3491
SEDIMENTATION, SUBARCTIC LANDSCAPES, ESTUARIES, EROSION, ENVIRONMENTAL IMPACT, WATER POLLUTION, SOIL POLLUTION, UNITED STATES—ALASKA—EAGLE RIVER FLATS, UNITED STATES—ALASKA—COOK INLET

The physical processes of sedimentation and erosion within the tidal mudflats and salt marshes of Eagle River Flats (ERF), an area used as an artillery impact range by the U.S. Army since 1945, must be understood to evaluate potential treatments of a high duck mortality resulting from ingestion of white phosphorus (WP) particles. The WP originates from smoke-producing devices detonated there. A preliminary assessment of erosion and sedimentation during May to Sep. 1992 indicates that the physical system is complex and the intensity of these processes spatially variable. Deposition from suspension sedimentation generally varied with morphology and elevation, increasing inland from levees on the Eagle River (1 to 2 mm) across vegetated (3 to 6 mm) and unvegetated (5 to 12 mm) mudflats, and into ponds (10 to 19 mm) and salt marshes (10 mm). Resedimentation rates in ponds ranged from 8 to 16 mm. Recession rates of eroding gully headwalls were highly variable, ranging from negligible to over 3.9 m. White phosphorus particles may be in suspended transport through gullies during ebb. Further studies are necessary to better define annual sedimentation and erosion rates, with improved sampling techniques used at an expanded number of sites. Basic data on tidal inundation, sediment influx and efflux, and WP particle transport are required to develop appropriate treatment methods.

CR 93-24 AUTOMATIC, CONTINUOUS RIVER STAGE MEASUREMENT WITH A MILLIMETER-WAVE FM-CW RADAR.

Yankielun, N.E., Ferrick, M.G., Dec. 1993, 8p., ADA-276 508, 16 refs.

48-3492
ICE BREAKUP, RIVER ICE, RADAR, MONITORS, UNITED STATES—CONNECTICUT RIVER

River stage measurements at many locations are fundamental for the analysis of dynamic events on rivers, including ice breakup, but these data are frequently unavailable. A high-resolution, broadband millimeter-wave (26.5 to 40 GHz) Frequency Modulated-Continuous Wave (FM-CW) radar, with real-time data acquisition and digital signal processing capability, was mounted from fixed locations on bridges over the Connecticut River to continuously acquire, process, store and display river stage data during controlled releases of water from a hydropower dam. The radar system provided continuous stage data of accuracy comparable to those acquired by a survey team and a permanent U.S. Geological Survey stream gauging station. The system can be rapidly installed and is capable of acquiring data, including event timing, at 1-, 10- or 60-second intervals, around-the-clock, without operator interaction or visual readings. The system sensor can be remotely mounted and monitored, thereby minimizing safety hazards to personnel using direct measurement techniques.

CR 93-25 AXIAL DOUBLE-BALL TEST VERSUS THE UNIAXIAL CONFINED COMPRESSION TEST FOR MEASURING THE COMPRESSIVE STRENGTH OF FRESHWATER AND SEA ICE.

Kovacs, A., Dec. 1993, 19p., ADA-277 025, 39 refs.

48-3494
SEA ICE, ICE STRENGTH, COMPRESSIVE PROPERTIES, POROSITY, ICE DENSITY

Axial double-ball load tests were made on freshwater ice and first-year and multiyear sea ice. From this simple test method the appar-

ent unconfined compressive strength of the ice was determined. These strength results were compared with those obtained from the complex and costly uniaxial unconfined compression test made on similar ice at a strain rate of 10^{-3} /s. The scatter in the test data and the average ice strength obtained from both test methods were similar. The findings indicate that the expedient axial double-ball load test is well suited for determining the unconfined compressive strength of ice, especially in the field where the demanding sample preparation requirements needed for unconfined compression test samples cannot be met.

CR 93-26 REASSESSMENT OF THE IN-SITU DIELECTRIC CONSTANT OF POLAR FIRN.

Kovacs, A., Gow, A.J., Morey, R.M., Dec. 1993, 22p., ADA-276 999, 39 refs.

48-3739

DIELECTRIC PROPERTIES, FIRN, ICE ELECTRICAL PROPERTIES, GLACIOLOGY, ICE SHELVES, RADIO ECHO SOUNDINGS, ANALYSIS (MATHEMATICS), ELECTROMAGNETIC PROPERTIES, WAVE PROPAGATION, ANTARCTICA—MCMURDO ICE SHELF

The success in using VHF and UHF frequency systems for sounding polar ice sheets has been tempered by an uncertainty in the *in situ* dielectric constant, which controls the effective velocity of an electromagnetic wave propagating in an air-ice mixture. An empirical equation for determining dielectric constant vs. density (specific gravity, ρ) was proposed in 1968 by Robin et al. where dielectric constant = $(1+0.851 \rho)^2$. However, this expression has met with uncertainty because wide-angle radar refraction sounding techniques have produced values of dielectric constant that are lower than Robin's equation predicts. This report discusses radar soundings made on the McMurdo Ice Shelf and compares the resulting dielectric constant values with Robin's equation, laboratory measurements on firn and ice, and other expressions given in the literature for determining dielectric constant vs. the specific gravity of dry firn and ice. The findings indicate that the form of Robin's equation is valid. However, the analysis also indicates the expression could be slightly improved to read dielectric constant = $(1+0.845 \rho)^2$. Reasons are suggested as to why previous wide-angle radar sounding studies did not reproduce Robin's findings. (Auth.)

CR 94-01 GROWTH CONDITION OF AN ICE LAYER IN FROZEN SOILS UNDER APPLIED LOADS. 2: ANALYSIS.

Nakano, Y., Takeda, K., Jan. 1994, 18p., ADA-278 154, 16 refs.

48-3793

ANALYSIS (MATHEMATICS), MATHEMATICAL MODELS, FROST HEAVE, FROZEN GROUND, SOIL FREEZING, ICE LENSES

The results of an experimental study on the steady growth condition of a segregated ice layer under various applied pressures were presented in Part 1. Using the data obtained, the accuracy of the model M_1 is evaluated and the predicted steady growth condition is found to be in good agreement with the condition found empirically. The concept of segregation potential introduced by Konrad and Morgenstern in the early 1980s is examined based on M_1 . M_1 is found to be consistent with the empirical data that were used to support their segregation potential theory.

CR 94-02 EXPERIMENTAL AND NUMERICAL ANALYSIS OF FLOATING ICE BEAM IMPACT FORCES AGAINST A SLOPED STRUCTURE.

Coutermarsh, B.A., Mar. 1994, 39p., ADA-280 752, 13 refs.

48-5148

ICE FLOES, ICE SOLID INTERFACE, IMPACT STRENGTH, BRIDGES, ANALYSIS (MATHEMATICS), MATHEMATICAL MODELS

Floating ice impact forces are of concern where structures are built in ice-susceptible waters. Bridge piers, ice control structures and ice-breakers are a few examples where the ability to predict the expected ice impact force would be of great help in the design process. Experiments were performed to determine the response of a floating ice beam to a vertically applied force. The data were used to calibrate a numerical finite element model of the floating ice. The ice was characterized as a linear elastic material in the numerical analysis, and the calibration data were used to assess this assumption as well as to develop a fluid influence coefficient matrix to simulate the dynamic influence of the fluid beneath the ice beam. Finally, a scale model study was performed to determine actual impact forces generated by a floating ice beam against a 45 deg sloped structure. The numerical model developed was then compared to the actual data. The numerical model does well at predicting impact forces for all the beams at low velocity and the force from the thicker ice beams at all velocities. Both the numerical and experimental forces show the same trends and appear to level off and approach a constant value with increasing beam length. The discrepancies between numerical predictions and experimental results are thought to be caused by damage in the experimental ice beams which is not accounted for in the numerical model.

CR 94-03 TRAVELING WAVE SOLUTIONS TO THE PROBLEM OF QUASI-STEADY FREEZING OF SOILS.

Nakano, Y., Mar. 1994, 19p., ADA-280 971, 10 refs.

49-5986

SOIL FREEZING, FREEZING FRONT, FROST HEAVE, FROZEN GROUND THERMODYNAMICS, ICE LENSES, MATHEMATICAL MODELS

The results of mathematical and experimental studies presented in preceding reports clearly show that the model M_1 accurately describes the properties of a frozen fringe when the steady growth of an ice layer occurs. In this work the steady growth of ice-rich frozen soil is studied by using M_1 . Deriving a traveling wave solution to the problem, the author has found that the condition of steady growth of ice-rich frozen soil is uniquely determined by a set of two physical variables, such as α_0 and α_1 used earlier, under given hydraulic conditions and over-burden pressures. The traveling wave solution converges to the solution to the problem of a steadily growing ice layer when the velocity of the 0°C isotherm relative to the unfrozen part of the soil vanishes.

CR 94-04 DEPENDENCE OF SEGREGATION POTENTIAL ON THE THERMAL AND HYDRAULIC CONDITIONS PREDICTED BY MODEL M_1 .

Nakano, Y., Apr. 1994, 10p., ADA-980 969, 25 refs.

48-5151

FROZEN GROUND, FROST HEAVE, MATHEMATICAL MODELS, ICE LENSES, ICE GROWTH

The segregation potential (SP) model is semiempirical in nature. An accurate mathematical model is needed that provides the functional dependence of SP on pertinent variables specifying given thermal and hydraulic conditions in terms of well-defined functions (or parameters) describing the properties of a given soil. In response to such a need, a mathematical model called M_1 was introduced and efforts have been made to validate M_1 with empirical findings and experimental data. In this report the author shows that the functional dependence of SP on pertinent variables predicted by M_1 is consistent with empirical findings that were used to build the SP model.

CR 94-05 MODEL FOR AVALANCHES IN THREE SPATIAL DIMENSIONS: COMPARISON OF THEORY TO EXPERIMENTS.

Lang, R.M., Leo, B.R., April 1994, 23p., Refs. p.21-23.

49-705

MATHEMATICAL MODELS, AVALANCHES, THEORIES, AVALANCHE MODELING, AVALANCHE MECHANICS

A three-dimensional theory is derived to describe the temporal behavior of gravity currents of cohesionless granular media, in an attempt to model the motion of dense, flow-type snow avalanches, ice and rock slides. A Mohr-Coulomb yield criterion is assumed to describe the constitutive behavior of the material, and the basal bed friction is described similarly by a Coulomb type of friction. A drag term is included in order to model the occurrence of flow regimes where boundary drag becomes non-negligible. Data from laboratory simulations are compared to a series of numerical studies based on the aforementioned theory. A nondimensional, depth and width averaged form of the theory is considered. A Lagrangian finite difference scheme is then applied to numerically model some limiting cases of the governing equations. Two different numerical models are developed, tested and compared to experimental values. The results indicate that the model can account for flow transitions by inclusion of the drag term when the initial inclination angle is large enough to affect boundary drag. Furthermore, the temporal and spatial evolution of the granulate and final runout position can be predicted to values well within the experimental error.

CR 94-06 GUIDELINES FOR MANAGING VEGETATION ON EARTH-COVERED MAGAZINES WITHIN THE U.S. ARMY MATERIEL COMMAND.

Palazzo, A.J., Gatto, L.W., Woodson, W., May 1995, 43p., ADA-284 275, Refs. p.23-25.

50-389

REVEGETATION, MILITARY OPERATION, COST ANALYSIS

The purpose of these guidelines is to assist land managers in establishing and maintaining vegetation on earth-covered magazines (ECMs) in a safe, efficient and cost-effective manner. Although the vegetation management procedures discussed here are intended primarily for conventional storage ECMs, not those used for special weapons, many of the general procedures and principles presented apply to both types. In humid areas a healthy vegetative cover on ECMs is the primary factor in maintaining the stable soil cover that is required to meet safety standards. Thus, a vegetation management planning process is presented that assists land managers in defining management goals, assessing climatic and soil factors and evaluating vegetation options. Specific methods and procedures that have proven successful for maintaining and re-establishing an effective vegetation cover are outlined. Other methods used to stabilize the ECM soil cover in dry climates, where cost-effective maintenance of vegetation can be difficult to impossible, are briefly discussed as well.

CR 94-07 SORPTION-DESORPTION AND TRANSPORT OF TNT AND RDX IN SOILS.

Selim, H.M., Iskandar, I.K., May 1994, 25p., ADA-285 570, 36 refs.

49-708

EXPLOSIVES, MILITARY OPERATION, SOIL POLLUTION, ADSORPTION, SOIL MECHANICS

Batch and miscible-displacement experiments were conducted to determine the extent of adsorption-desorption and transport of 2,4,6-trinitrotoluene (TNT) and 2,3,5-trinitro-1,3,5-triazine (RDX) in soils. A reference bentonite clay, contaminated (Kolin) soil from the Louisiana Army Ammunition Plant, and two uncontaminated soils were used. The TNT isotherm for bentonite clay was described equally well using linear, Freundlich, Langmuir and modified Langmuir models. TNT adsorption and desorption isotherms showed a lack of hysteric behavior, with TNT retention as a fully reversible mechanism. Transport results from bentonite clay columns indicated that TNT was a highly mobile contaminant and fully conservative in the presence of methanol as the background solution. Mobility of TNT was strongly retarded, with some 50% of the applied TNT retained in the bentonite clay column when 0.005-M $\text{Ca}(\text{NO}_3)_2$ was the background solution. Transport results in Norwood (fine silty) soil columns revealed that TNT was strongly retained in this low-organic-matter and low-clay-content soil. The use of a transport model with either Freundlich or linear retention and an irreversible mechanism predicted the TNT transport data well. Poor predictions were obtained when model parameters based on batch retention data were used. Reasons for model failure may be attributable to TNT sorption-kinetics and retention because of diffusion into clay lattices. Transport results indicated high mobility of RDX with limited retardation, which is consistent with release and transport data from the contaminated soil.

CR 94-08 AIR EXCHANGE MEASUREMENTS IN ARMY BUILDINGS.

Flanders, S.N., July 1994, 28p., ADA-288 246, 6 refs.

49-3028

VENTILATION, BUILDINGS, FLOW MEASUREMENT, AIR LEAKAGE

Air exchange measurements in buildings are important for testing the effectiveness of the ventilation system and for characterizing air leakage in the building envelope when the ventilation is off. This report discusses such measurements in nine Army buildings—administrative, maintenance, barracks, hospital and laboratory buildings—using a tracer gas method that entails releasing a tracer gas in an initial well-mixed concentration and then monitoring its concentration over time. The faster the tracer gas dilutes, the greater is the air change rate. ASTM Standard E741 offers techniques for tracer gas measurements in single-zone enclosures, but most Army buildings are multiple-zone enclosures. This study, looking at whether such buildings could approximate single-zone enclosures for tracer gas measurements, found that this is difficult. In addition, a number of buildings were detected in which the mechanical ventilation system was working at a fraction of design capacity.

CR 94-09 INITIAL OBSERVATIONS OF SALT SIEVING IN FROZEN SOIL.

Black, P.B., Aug. 1994, 9p., ADA-286 373, 13 refs.

49-1561

MOISTURE TRANSFER, SOIL WATER MIGRATION, UNFROZEN WATER CONTENT, SOIL FREEZING, MATHEMATICAL MODELS

The role of solutes in the transport of water through frozen porous media is more complicated and subtle than simply lowering the freezing point of the water. This report presents evidence that unfrozen water films in soil act as a semipermeable membrane selectively filtering solutes. The calculated film thickness at the test temperature (-0.05°C) indicates that all solute should pass. The additional influence of anion exclusion arising from a diffuse electrical double layer suggests that solute movement is restricted and a "salt-sieving" process results. Experimental observations are reported for a specially designed constant-volume ice-sandwich permeameter. Proposed research for a constant-stress ice-sandwich permeameter is presented as a means of overcoming experimental uncertainties of the present system.

CR 94-10 DESIGN AND EVALUATION OF A TOWED SNOWPLOW FOR THE SMALL UNIT SUPPORT VEHICLE (SUSV): FULL-SCALE PROTOTYPE DEVELOPMENT AND 1992 FIELD TESTS.

Richmond, P.W., Walsh, M.R., Oct. 1994, 17p. + appends., ADA-289 688, 6 refs.

49-3650

SNOW REMOVAL, EQUIPMENT, MACHINERY, MILITARY EQUIPMENT, DESIGN, MECHANICAL TESTS

Light Infantry Division elements require a system to allow them to conduct semi-autonomous operations and limited self-resupply with existing wheeled vehicles in snow deeper than 15 cm. Since many roads and trails will not have been kept open prior to deployment, truck-mounted plows (if available) would be ineffective. In most instances, heavy tracked vehicles, which can cause extensive environmental damage, are required to move deep snow. Over-snow

vehicles can be equipped with front- or rear-mounted plow blades. But to adapt a plow to the U.S. Army's only over-snow vehicle, the small unit support vehicle (SUSV), would require major vehicular modifications. A towed plow assembly for the SUSV was proposed. To adapt the plow for this application, a unique four-bar parallel linkage towing assembly was developed, which bolts directly on to the SUSV's pintle hook mounting bracket. This assembly controls the pitch, and the plow geometry stabilizes the roll of an attached plow. The plow was constructed primarily of aluminum, has three plowing widths, and can be towed over the road (minimum width 2.3 m). This report describes the design, operation and results of field tests of the towing assembly and plow. The SUSV successfully towed the plow through deep (85 cm) unbonded snow, creating a path wide enough for a wheeled vehicle. In hard, dense, wind-blown snow the plow was less successful, requiring several passes to open a trail. No major failures occurred, although some minor problems were identified. Recommendations for design improvements are presented.

CR 94-11
SOIL MOISTURE PREDICTION DURING FREEZE AND THAW USING A COUPLED HEAT AND MOISTURE FLOW MODEL.
Bigl, S.R., Shoop, S.A., Nov. 1994, 19p., ADA-289 343, 17 refs.
49-3265

FROST HEAVE, SOIL FREEZING, FREEZE THAW CYCLES, COMPUTERIZED SIMULATION, SOIL WATER, THAW DEPTH, FROST PENETRATION
A coupled heat flow and moisture flow model (FROSTB) was used to simulate large scale freeze-thaw experiments to assess its ability to predict soil moisture conditions during freeze and thaw. The experimental data consist of temperature and soil moisture profiles through freeze-thaw cycles of a 1-m layer of frost-susceptible silty sand over roughly 2 m of gravelly sand. Two experimental conditions were modeled: 1) where the soil moisture was lower than specific retention (less than 12% by weight) and no water table was present (dry case) and 2) where the soil was fairly wet and the water table was approximately 1 m deep (wet case). During freezing, FROSTB tends to predict ice contents higher than those observed, which causes the simulated soil column to thaw slower. During thawing the predicted moisture contents in the thawed soil were close to the measured values for the wet case but were always higher than the measured moisture contents for the dry case. Possible reasons for the discrepancy are discussed.

CR 94-12
SUBSURFACE RADAR INVESTIGATIONS AT THE PEGASUS GLACIAL-ICE RUNWAY AND WILLIAMS FIELD, MCMURDO STATION, ANTARCTICA.
Arcone, S.A., Delaney, A.J., Tobiasson, W., Nov. 1994, 23p., ADA-289 232, 29 refs.
49-3651

ICE RUNWAYS, RUNWAYS, SUBSURFACE INVESTIGATIONS, DATA PROCESSING, RADAR, ICE COVER THICKNESS, ICE STRUCTURE, ENVIRONMENTAL IMPACT, ANTARCTICA—MCMURDO STATION, ANTARCTICA—ROSS ICE SHELF
Subsurface radar was used to profile ice and snow conditions on the Ross Ice Shelf at McMurdo Station during mid-Jan. 1993. Deconvolution and migration were often used to improve vertical resolution and spatial imaging. Profiles at a pulse center frequency of 400 MHz along the 3.2-km long Pegasus ice runway show many low-density horizons above 9 m depth that are up to 30 m long. They are associated with air bubbles included during refreezing of meltwater and are interpreted as layers between a few to tens of centimeters thick. There is a strong reflecting horizon at about 9 m depth that is probably from brine intrusion, as it is continuous with the intrusion into the snow to the east. Diffraction asymptotes give a dielectric constant near 3.2 for material above the brine level, a value that implies near-solid ice. Profiles at 100 MHz along the road between Pegasus runway and Williams Field in the accumulation zone show snow features such as layer deformation and intrusive brine layers that both abruptly and gradually change in depth. A single profile at a relic solid waste dump at Williams Field detected buried debris and ice within the upper 7 m. A survey of a suspected fuel spill shows some local disturbances near the center, but no excavation was done to verify the findings. Profiles traversing the sewage sumps at Williams Field outline the extent of the sewage deposition, and give depths to contaminated snow that closely agree with observations. Despite variability in dielectric properties, single-layer migration effectively improves the resolution of subsurface conditions. Recommendations are made for future surveys. (Auth.)

CR 94-13
ANALYZING THE STABILITY OF FLOATING ICE FLOES.

Coutermarsh, B., McGilvary, R., Dec. 1994, 19p., ADA-292 149, 9 refs.

49-4093

ICE FLOES, ICE PRESSURE, RIVER ICE, ICE COVER, ICE DENSITY, ICE COVER THICKNESS, ANALYSIS (MATHEMATICS), HYDRODYNAMICS
This report describes an experimental study to measure the pressure caused by fluid acceleration beneath a floating parallelepiped block. Dynamic fluid pressure was measured at discrete points beneath the

block for several flow velocities, flow depths, block angles of attack and block-thickness-to-depth ratios. The measured pressures were used to calculate block overturning moments, and a hydrostatic analysis was used to calculate a block righting moment. From this, a densimetric Froude overturning criterion is presented. The measured hydrodynamic pressure distribution on the bottom of a single model ice floe is used to estimate the dynamic stability at three thickness-to-depth ratios. The energy-based analysis details the conditions required for instability, metastability and stability. At three thickness-to-depth ratios, block rotational inertia has the effect of reducing the Froude stability number by 5 to 10% over a completely static stability criterion.

CR 95-01
COLD REGIONS MOBILITY MODELS.

Richmond, P.W., Shoop, S.A., Blaisdell, G.L., Feb. 1995, 72p., ADA-293 728, 25 refs.

49-5197

TRACKED VEHICLES, VEHICLE WHEELS, TRACTION, COMPUTER PROGRAMS, MATHEMATICAL MODELS
This report annotates the cold regions mobility prediction routines included in the CAMMS/ALBE mobility models. It further explains the development of algorithms that are used in these models to describe the interaction of a vehicle with terrain that has been affected by cold weather. The following terrain conditions are discussed: undisturbed snow (shallow and deep); disturbed snow (moderately trafficked and hard packed); ice; and thawing soils. Several combinations of substrates are also considered. A stand-alone computer model is included.

CR 95-02
MODELING-BASED EVALUATION OF THE EFFECT OF WASTEWATER APPLICATION PRACTICES ON GROUNDWATER QUALITY.

Reynolds, C.M., Iskandar, I.K., Feb. 1995, 38p., ADA-293 491, 33 refs.

49-5195

GROUND WATER, SOIL WATER, COMPUTERIZED SIMULATION, WASTE DISPOSAL, WASTE TREATMENT, MODELS

The model WASTEN was used to compare several nitrogen input scenarios and to predict the levels of nitrate in groundwater for a proposed wastewater treatment facility at Fort Dix, NJ. The primary variables tested were input concentration of $\text{NO}_3\text{-N}$ (nitrate nitrogen) and $\text{NH}_4\text{-N}$ (ammonium nitrogen) and long-term application of wastewater. Two $\text{NO}_3\text{-N}$ loading rates, 4 and 10 mg $\text{NO}_3\text{-N/L}$, were tested for 168-day simulations. The system's response was estimated from the $\text{NO}_3\text{-N}$ concentration in water draining below 150 cm. For both input $\text{NO}_3\text{-N}$ concentrations, the predicted $\text{NO}_3\text{-N}$ concentrations in the leachate below 150 cm were less than 2 mg $\text{NO}_3\text{-N/L}$. The initial $\text{NO}_3\text{-N}$ in the soil profile represented typical background levels for this site. The final $\text{NO}_3\text{-N}$ in the soil profile was affected by both denitrification and leaching. The initial $\text{NH}_4\text{-N}$ in the simulated soil profile was equal to the extractable $\text{NH}_4\text{-N}$ from soil samples taken at the Fort Dix site. Because a portion of the extractable $\text{NH}_4\text{-N}$ exists as exchangeable rather than solution $\text{NH}_4\text{-N}$, the soil profile values for the solution $\text{NH}_4\text{-N}$ used in the simulation were greater than actual soil solution values would be. Moreover, by adjusting model coefficients, all the initial $\text{NH}_4\text{-N}$ was forced to leach in the model simulations rather than be subjected to nitrification, denitrification, immobilization or plant uptake. Due to the retardation effects on $\text{NH}_4\text{-N}$ mobility caused by soil-ion sorption, the $\text{NH}_4\text{-N}$ leaching was distributed over an extended time rather than moving rapidly below the unsaturated zone.

CR 95-03
TRANSPORT OF TRACER BR IN FROZEN MORIN CLAY IN RESPONSE TO TEMPERATURE GRADIENTS.

Nakano, Y., Feb. 1995, 10p., ADA-293 466, 15 refs.

49-5196

CLAYS, FROST HEAVE, IONS, TEMPERATURE GRADIENTS

The movement of water and Br was measured in unsaturated and partially frozen soil columns subjected to linear temperature fields. Both water and Br moved from the warmer to cooler parts in the columns. The data were analyzed under the assumption that Br is confined to unfrozen water. It was found that the negative adsorption of Br by clay surfaces plays a significant role in the transport of Br in frozen Morin clay and that Br tends to move faster than unfrozen water.

CR 95-05
INITIAL ANALYSES OF EAGLE RIVER FLATS HYDROLOGY AND SEDIMENTOLOGY, FORT RICHARDSON, ALASKA.

Lawson, D.E., Bigl, S.R., Bodette, J.H., Weyrick, P., Mar. 1995, 38p., ADA-298 690, Refs. p.34-36.

50-392

HYDROLOGY, SEDIMENTATION, ENVIRONMENTAL IMPACT, MILITARY OPERATION, SWAMPS, SEDIMENT TRANSPORT, RUNOFF, UNITED STATES—ALASKA—EAGLE RIVER FLATS

The physical environment of Eagle River Flats (ERF), a subarctic tidal flat and salt marsh, is progressively changing because of the interactions of multiple physical processes, including a high tidal range, two primary sediment sources, cold climate and location

within an active earthquake zone. In addition, ERF has been used by the U.S. Army as an artillery range, where high explosives or smoke-producing shells have been detonated, causing cratering and disrupting drainage. The physical environment of ERF needs to be understood to help remediate a problem of unusually high mortality rates in migrating waterfowl. This high mortality of ducks is attributable to ingestion of elemental white phosphorus (P_4) particles (from smoke-producing devices), which are now distributed within near-surface sediments of the ponds and marshes. The complexity of this dynamic environment makes it extremely difficult to predict what physical effects remedial measures for the P_4 contamination will have and, conversely, what short- and long-term effects the physical system will have on the effectiveness and success of proposed remedies. Understanding both the system's response and the effects of remedial technologies is critical to deciding what measures are used. This report presents the initial analysis of the physical processes of erosion, sedimentation and sediment transport and the factors controlling their activity within a portion of ERF.

CR 95-06
APPLICATIONS OF THE CLAPEYRON EQUATION TO WATER AND ICE IN POROUS MEDIA.

Black, P.B., Mar. 1995, 7p., ADA-294 677, 17 refs.

49-6268

ANALYSIS (MATHEMATICS), ICE WATER INTERFACE, MASS FLOW, FROZEN GROUND, POROUS MATERIALS
The equilibrium condition for water and ice in an ice-free porous medium is presented. The equation of state for this system is the Clapeyron equation. This equation is presented in a general form that explicitly shows the pressure-difference dependence with temperature for water and ice. Five solution scenarios are then discussed in terms of applicability to porous media.

CR 95-08
PERMAFROST FORMATION TIME.

Lunardini, V.J., Apr. 1995, 44p., ADA-295 515, 35 refs.

49-6269

PERMAFROST ORIGIN, PERMAFROST THICKNESS, PALEOCLIMATOLOGY, FREEZE THAW CYCLES, HEAT BALANCE, LATENT HEAT, THERMAL CONDUCTIVITY, MATHEMATICAL MODELS, COMPUTER PROGRAMS
The age of permafrost is closely linked to the time required for soil systems to freeze, since the permafrost must be at least as old as the formation time. Cycles of freeze-thaw will complicate the relation between the freeze rate and the age. A model based on pure conduction heat transfer with freeze-thaw is used to predict the time required for a given thickness of permafrost to develop, either heterogeneously or syngenetically. The formation time is a function of the long-term geothermal gradient (initial temperature of the thawed soil), the ratios of the frozen to thawed thermal properties, and the temperature history of the upper surface of the permafrost (higher than the air temperature). The simple theory allows universal graphs to be produced that predict the formation time for a given thickness of permafrost. Realistic soil property ratios and paleotemperature scenarios will then lead to estimates of the formation time of permafrost for a specific site. The model indicates that deep permafrost (more than 1500 m) requires formation times on the order of the complete Quaternary Period.

CR 95-09
INITIAL RESULTS FROM SMALL-SCALE FROST HEAVE EXPERIMENTS IN A CENTRIFUGE.

Ketcham, S.A., Black, P.B., May 1995, 18p., ADA-299 023, 22 refs.

50-728

FROST HEAVE, MODELS, MATHEMATICAL MODELS
Frost heave modeling is presented as a problem of small-scale experimental modeling. Scale factors applicable to frost heave model testing are reviewed, and initial data from frost heave experiments conducted as centrifuge model tests are presented. Ongoing improvements, modifications and future model tests are discussed.

CR 95-10
WINTER NAVIGATION ON THE GREAT LAKES: A REVIEW OF ENVIRONMENTAL STUDIES.

Wuebben, J.L., ed, May 1995, 52p., ADA-295 586, Refs. p.47-52.

49-6270

ICE NAVIGATION, OIL SPILLS, ENVIRONMENTAL IMPACT, SEDIMENT TRANSPORT, SHORE EROSION, COUNTERMEASURES, ICE CONTROL, HEAT TRANSFER, RIVERS, LAKES, GREAT LAKES

In 1970, Congress authorized a three-part Great Lakes-St. Lawrence Seaway Navigation Season Extension Program. It authorized a winter navigation demonstration program, a detailed survey study of season extension feasibility and a study of insurance rates for shippers. This report provides a review of numerous environmental and engineering studies conducted as part of the demonstration and feasibility portions of the program, as well as many environmental studies conducted after the completion of the original program. Topics include sediment transport, shoreline erosion, shore structure damage, oil and hazardous substance spills, biological effects, ship-induced vibrations and ice control systems.

CR 95-11 RIGIDICE MODEL OF SECONDARY FROST HEAVE.

Black, P.B., May 1995, 32p., ADA-297 392, 17 refs. 49-6335

FROZEN GROUND MECHANICS, FROZEN GROUND STRENGTH, SOIL FREEZING, FROST HEAVE, MATHEMATICAL MODELS, ICE SOLID INTERFACE, ICE LENSES, ICE FORMATION, ICE MODELS, COMPUTER PROGRAMS

A revised version of an earlier attempt to numerically solve Miller's equations for the RIGIDICE model of frost heave is presented that corrects earlier mistakes and incorporates recent improvements in the scaling factors of ground freezing. The new version of the computer code also follows the concepts of Object Oriented Numerics, which allow for easy modification and enhancements. Analysis of the program is accomplished with the symbolic math program MathCad. A brief sensitivity analysis of the input variables indicates that those parameters that determine the hydraulic conductivity have the greatest influence on the variability of predicted heaving pressure.

CR 95-11 SEALANTS AND COLD REGIONS PAVEMENT SEALS—A REVIEW.

Ketcham, S.A., May 1995, 20p., ADA-297 360, 53 refs.

49-6336

PAVEMENTS, DEFORMATION, COLD WEATHER PERFORMANCE, COLD WEATHER TESTS, PROTECTIVE COATINGS, SEALING, JOINTS (JUNCTIONS), POLYMERS, MECHANICAL PROPERTIES, VISCOELASTICITY, STANDARDS

This report reviews the specific problems and requirements that cold climates create for the performance of elastomeric seals. Emphasis is placed on the material response behavior that can lead to failure of a seal. In an attempt to clarify the mechanics of sealant and seal performance associated with low-temperature pavement applications and to address the issue of low-temperature stiffening that should be a dominant factor in the selection of a sealant, this report presents background information on the formulation and mechanical properties of elastomeric seal materials and the structural behavior of field-molded joint and crack seals.

CR 95-13 HEAT TRANSFER AND FROST-THAW PENETRATION IN SOIL SURROUNDING AN INCLUSION OF SAND; NUMERICAL MODEL RESULTS RELEVANT TO ELECTROMAGNETIC SENSOR SYSTEM PERFORMANCE.

Peck, L., O'Neill, K., July 1995, 22p., ADA-299 439, 12 refs.

50-726

HEAT TRANSFER, FROST PENETRATION, THAW DEPTH, SOIL TEMPERATURE, SOIL WATER, SANDS, FREEZING FRONT, HEAT CAPACITY, THERMAL CONDUCTIVITY, MATHEMATICAL MODELS, ELECTROMAGNETIC PROSPECTING

One- and two-dimensional numerical simulations of heat flow in silty soil with and without a sand inclusion have determined the magnitude and the lateral extent of the disruption in frost and thaw penetration attributable to the presence of the inclusion. Four different soil temperature histories, derived from field data at a Vermont site, were used as the surface boundary condition for the winter-long simulations. This identified differences in frost depth and soil temperature resulting solely from an overall colder or warmer soil surface condition. For a given surface boundary condition, the moisture content of the soil was varied to contrast the changes in frost penetration caused by the moisture-dependent differences in soil thermal conductivity and latent heat. The drier sand with its smaller latent heat freezes more rapidly than does the soil under identical conditions, so initially frost penetration is greater when the sand inclusion is present because the freezing front proceeds rapidly through the sand. Subsequently, the freezing front is deeper in soil without a sand inclusion. The less conductive sand impedes heat flow toward the soil surface, resulting in higher soil temperatures beneath the inclusion, which in turn retards freezing of the soil. Frost penetration beneath a sand inclusion is deeper the drier the soil is; with no sand inclusion present, frost depth is greater the more moist the silty soil is.

CR 95-14 LITERATURE REVIEW ON DECONTAMINATING GROUNDWATER SAMPLING DEVICES; ORGANIC POLLUTANTS.

Parker, L.V., July 1995, 15p., ADA-299 046, 40 refs. 50-729

GROUND WATER, SAMPLING, PERFORMANCE, COLD WEATHER PERFORMANCE, WATER POLLUTION, PUMPS Current protocols for decontaminating devices used to sample groundwater for organic contaminants are reviewed. Most of the methods given by regulatory agencies provide little scientific evidence that justify the recommended protocols. In addition, only a few studies that actually compare various decontamination protocols could be found in the open literature, and those studies were limited in their scope. Various approaches for decontamination and criteria that are important in determining how effectively a surface could be

decontaminated are discussed.

CR 95-15 WINTER LOW-FLOW BALANCE OF THE SEMIARID WHITE RIVER, NEBRASKA AND SOUTH DAKOTA.

Ferrick, M.G., Mulherin, N.D., Calkins, D.J., July 1995, 26p., ADA-299 537, 22 refs.

50-1074

RIVERS, RIVER ICE, WATER BALANCE, RIVER FLOW, STREAM FLOW, GROUND WATER, UNITED STATES—NEBRASKA, UNITED STATES—SOUTH DAKOTA, UNITED STATES—WHITE RIVER

Low-flow studies are needed to quantify the effects of water consumption on stream flow, water quality, groundwater resources, and contaminant transport. The low-flow water balance of a river in a cold region is simplified in winter because evapotranspiration is negligible, irrigation water withdrawals and diversions are halted, and precipitation occurs largely as snow, minimizing the spatial and temporal variability of runoff. The authors investigated the monthly low-flow water balance of White River (NE and SD) reaches over seven consecutive winters. Water going into or out of storage as ice or melt, obtained with an air temperature index model, can be a dominant component of the water balance. The point estimate method is used to account for parameter uncertainty and variability, providing the mean, variance, and limits of dependent variables such as water storage as ice and inflow from a subbasin. Negative surface water yield from several-thousand-sq-km subbasins occurred regularly through the period, indicating a significant flow from the river to the alluvial aquifers. The winter water balance results suggest either a perched river or a coupled surface water-groundwater hydrologic system in particular subbasins, consistent with the field investigations of Rothrock (1942). The winter flow exchange between the surface and subsurface can be used to estimate the annual exchange for both hydrologic conditions.

CR 95-16 PHYSICALLY BASED MODEL OF THE FORM DRAG ASSOCIATED WITH SASTRUGI.

Andreas, E.L., July 1995, 12p., ADA-298 688, 31 refs.

50-237

SASTRUGI, AIR ICE WATER INTERACTION, SNOW-DRIFTS, DRIFT, SNOW COVER EFFECT, MATHEMATICAL MODELS, ANTARCTICA—WEDDELL SEA

On Ice Station Weddell, some characteristics of the neutral-stability air-ice drag coefficient at a reference height of 10 m (C_{DN10}) were observed that had not been documented before. The main finding was that wind-driven snow continually alters the sea ice surface; the resulting snowdrifts determine how large C_{DN10} is. In particular, this report describes three observations and attempts to explain them: 1) C_{DN10} is near 1.5×10^{-3} when the wind is well aligned with the drifted snow; 2) C_{DN10} is near 2.5×10^{-3} when the wind makes a large angle with the dominant orientation of the snowdrifts; 3) C_{DN10} can increase by 20% if, after being well aligned with the drift patterns, the mean wind direction shifts by as little as 20°. To investigate this behavior of C_{DN10} , this report adopts a model developed by Raupach that partitions the total surface stress into contributions from form drag and skin friction. With reasonable choices for free model parameters and with little fine-tuning, this physically based model can reproduce the three main observations. In other words, the model seems to include the basic physics of air-ice momentum exchange. This modeling implies that 10-cm high sastrugi-like roughness elements, rather than pressure ridges, sustain most of the form drag over compact sea ice in the western Weddell Sea. Lastly, the report speculates on what the observations and this model say about how to parameterize C_{DN10} over snow-covered sea ice. (Auth.)

CR 95-17 OPTIMAL DESIGN OF PIPING SYSTEMS FOR DISTRICT HEATING.

Phetteplace, G., Aug. 1995, 93p., ADA-300 411, 44 refs.

50-1519

HEAT TRANSFER, DESIGN, HEATING, HEAT PIPES, COMPUTER PROGRAMS, ANALYSIS (MATHEMATICS), COST ANALYSIS, MATHEMATICAL MODELS

First, a method for determining the optimal size for a single pipe segment in a district heating system is developed. The method is general enough to allow for any set of economic or physical parameter values. In addition, any form of load management, i.e., temperature or flow modulation, or both, can be accommodated by the integral form of the coefficients in the cost equation. An example is presented that shows a 17% savings in life cycle costs over a design based on a common rule of thumb. Next the heat consumer and its effects on the piping system are studied. A new model is developed for the consumer's heat exchanger that uses the geometric mean temperature difference as an approximation for the logarithmic mean temperature difference. The new consumer model is integrated into the previous single pipe model and, for a sample case, its effect is determined. For systems having multiple pipes and consumers, the constraints are first developed and then the general solution strategy. The method makes use of the solution to the unconstrained problem as a starting point for the constrained solution. Monotonicity analysis is then used to prove activity of some of the constraints, and thus simplify the problem. Finally, the branch-and-bound technique is shown to be suitable for finding a design with discrete values for all the pipe

diameters. A simple example is provided. A method is also demonstrated for further refinement of the pipe network to eliminate excessive throttling losses in the consumer's control valves. The method developed here should be feasible for designing the piping networks for district heating systems of moderate size, and its major advantage is its flexibility.

CR 95-18 EFFICIENCY OF STEAM AND HOT WATER HEAT DISTRIBUTION SYSTEMS.

Phetteplace, G., Sep. 1995, 24p., ADA-302 238, 21 refs.

50-2390

HEATING, STEAM, HEAT LOSS, HEAT PIPES, UNDERGROUND PIPELINES, COST ANALYSIS

This report will provide some general guidance on the selection of distribution medium (steam or hot water) and temperature for heat distribution systems. The report discusses the efficiency of both steam and hot water heat distribution systems in more detail. The results of several field studies using data from boiler plant logs and measured heat losses are given. For steam, an efficiency analysis for the steam heat distribution system at Hawthorne Army Ammunition Plant is summarized. This analysis is based on the limited data available from the boiler logs maintained at the central plant. From this information, along with energy and mass balances that are constructed from the central plant data, gross measures of efficiency are obtained. The results of the analysis show that only 43.5% of the steam input to the distribution system is used to meet the required space heating load. The results also indicate that on average only 46.2% of the steam that leaves the plant returns as condensate. By converting this steam distribution system to a low temperature hot water heat distribution system, savings would exceed \$292,000 for the 181-day study period, which represents a typical heating season. For hot water based systems this report describes two field projects underway at U.S. Army bases, at Fort Jackson, SC and Ft. Irwin, CA.

CR 95-19 ICE JAM FLOODING ON THE MISSOURI RIVER NEAR WILLISTON, NORTH DAKOTA.

Wuebben, J.L., Gagnon, J.J., Sep. 1995, 25p., ADA-301 513, 29 refs.

50-2707

RIVER FLOW, WATER LEVEL, FLOODING, ICE JAMS, ICE COVER EFFECT, ICE CONDITIONS, CLASSIFICATIONS, FLOOD FORECASTING, FLOW CONTROL, ICE CONTROL, COUNTERMEASURES, UNITED STATES—NORTH DAKOTA—MISSOURI RIVER

This investigation focuses on ice-related flooding along the Missouri River, just below the confluence with the Yellowstone River near Williston, ND. This area is at the upper end of Lake Sakakawea. With the closure of Garrison Dam in 1953, Lake Sakakawea began filling, reaching operational levels in 1965. Changes in the hydraulics, sedimentation and ice regime of the Missouri River caused by the impoundment have led to an increase in the potential for over-bank flooding. This report describes the ice regime assessment that was conducted to characterize ice jam flooding, the development of a method to predict the potential for ice jam occurrence and severity, and potential flood mitigation measures.

CR 95-21 DOPPLER RADAR FOR CONTINUOUS REMOTE MEASUREMENT OF RIVER ICE VELOCITY.

Ferrick, M.G., Yankielun, N.E., Nelson, D.F., Nov. 1995, 11p., ADA-305 808, 12 refs.

50-4247

RIVER ICE, ICE MECHANICS, ICE FLOES, ICE BREAKUP, FRAZIL ICE, VELOCITY MEASUREMENT, ACCURACY, RADAR, UNITED STATES—CONNECTICUT RIVER

River ice velocity measurements are fundamental to analyses of river ice dynamics. Ice velocity measurement with a continuous-wave Doppler radar system having real-time data acquisition and digital signal processing capability was evaluated during a river breakup and a frazil run on the Connecticut River. This system can be rapidly deployed, requires minimal operator interaction, will continuously acquire, process, store, and display ice velocity data and does not depend on visibility conditions. In parallel, video records of ice motion were obtained at the same location for later manual processing and comparison with the radar results. The authors describe the Doppler radar system and obtain bounding estimates of possible measurement errors. The principal error in Doppler ice velocity measurement is due to the beamwidth of the radar antenna, and an analytical method is developed to minimize this error. Measured ice velocities ranged from 1 to 25 m/s during the river breakup and from 0.5 to 0.65 m/s in the frazil run.

CR 95-22 SENSIBLE HEAT FLUX MEASUREMENTS NEAR A COLD SURFACE.

Yen, Y.-C., Oct. 1995, 43p., ADA-304 592, Refs. p.40-43.

50-879

HEAT FLUX, TEMPERATURE VARIATIONS, TURBULENCE, VELOCITY MEASUREMENT, WIND VELOCITY, ANEMOMETERS, SNOW COVER EFFECT, AIR TEMPERATURE, ATMOSPHERIC BOUNDARY LAYER, ANALYSIS

(MATHEMATICS), FROZEN GROUND

A unidirectional sonic anemometer with a fine-wire thermocouple in conjunction with a hot film anemometer were employed to measure the turbulent fluctuating velocities of w' , u' , and the fluctuating temperature T' . Covariance were evaluated to compute the turbulent heat flux and the friction velocity. Based on preliminary data, it can be noted that the values of fluctuating vertical velocity and temperature, the friction velocity, and the standard deviations of vertical and horizontal turbulent fluctuating velocities can all be correlated rather well with a single variable, i.e., the mean wind speed measured at a height of 2 m. In all the plots of friction velocity, vertical and horizontal turbulent fluctuating velocities, and the fluctuating vertical velocity and temperature vs. the mean wind speed at 2 m, the slopes are slightly lowered as the test season progressed from early summer to the winter. The most striking reduction can be observed in the case of the fluctuating vertical velocity and temperature vs. mean wind speed at 2 m. During the winter period, the slope is only about one third of that during the spring-summer period. In other words, under unstable conditions, for the same mean wind speed, the heat flux during the winter is only about one third of the flux that would have occurred during the spring-summer. Under stable conditions, the magnitude of the fluctuating vertical velocity and temperature is much smaller, and its value shows much greater dispersion.

CR 95-23**PERSISTENCE OF WHITE PHOSPHORUS PARTICLES IN SEDIMENT.**

Walsh, M.E., Collins, C.M., Racine, C.H., Nov. 1995, 46p., ADA-303 741, 49 refs.
50-878

SEDIMENTS, SOIL POLLUTION, ENVIRONMENTAL IMPACT, WETLANDS, PONDS, LEVEES, PARTICLES, MOISTURE, UNITED STATES—ALASKA—EAGLE RIVER FLATS

Remediation of sediments at Eagle River Flats, a salt marsh contaminated with particles of white phosphorus (P_4), may require severe alterations of the wetland by dredging, draining or covering. However, some sediments may undergo decontamination naturally in areas that are seasonally exposed to air. To predict the persistence of white phosphorus particles in sediments, a literature review was conducted for the physical and chemical properties of white phosphorus. The persistence of millimeter-size white phosphorus particles was studied by laboratory and field experiments. White phosphorus particles were found to be persistent indefinitely in saturated sediments. In unsaturated sediments, loss was rapid (within 24 hours) at 20°C but retarded by low temperatures.

CR 95-24**GROUND-PENETRATING RADAR INVESTIGATION OF THE PROPOSED DOME-CARA TUNNEL ROUTE AND UTILITIES AT SOUTH POLE STATION, ANTARCTICA.**

Arcone, S.A., Tobiasson, W., Delaney, A.J., Dec. 1995, 24p., ADA-306 940, 19 refs.
50-4543

RADAR ECHOES, SUBSURFACE INVESTIGATIONS, REMOTE SENSING, TUNNELING (EXCAVATION), TUNNELS, RADAR, SITE SURVEYS, ANTENNAS, ANTARCTICA—AMUNDSEN-SCOTT STATION

Ground-penetrating radar studies were performed at Amundsen-Scott Station during Jan. 1993 to determine if subsurface obstructions exist along a planned tunnel route from the main station to the new astrophysical research area on the far side of the skiway, and if various man-made subsurface features such as sewage sumps, a water well, utilidor and buried buildings could be located and delineated. The maximum depth of interest for the tunnel survey was approximately 10 m. For it, a short-pulse antenna transducer with its antenna bandwidth centered near 400 MHz was towed along the ground surface over multiple traverses to cover an area up to 60 m wide. The survey extended from the Amundsen-Scott Station fuel arch, across the skiway and then to the CARA site (Center for Astrophysical Research in Antarctica). The radar profiles show reflections from density layering within the snow caused by traffic and diffractions from artificial features within 13 m depth. Debris is present in the snow west of the skiway and near the fuel bladder near the taxiway. Targets within 100 m of the west side of the skiway are extensive, and appear to be metallic. The tunnel should be routed in the clear area north of them. Targets near the fuel bladder are only 3 to 4 m below the surface. The tunnel could go under them, but as a precaution they could be removed. An additional survey was run over a 30 m wide swath from the ASTRO facility at the CARA site to the new elevated dormitory, a distance of approximately 800 m. (Auth. mod.)

CR 95-25**TEMPORAL WEATHER IMPACTS UPON EXTERIOR INTRUSION DETECTION SYSTEMS.**

Ryerson, C.C., Peck, L., Dec. 1995, 138p., ADA-306 810, Refs. passim.
50-4544

MONITORS, WARNING SYSTEMS, COUNTERMEASURES, COLD WEATHER OPERATION, PERFORMANCE, ACCURACY, FOG, ICING, SNOW COVER EFFECT, ICE COVER EFFECT, SOIL FREEZING, SOIL WATER, ALBEDO, SOLAR RADIATION

Fundamentally, an electronic exterior intrusion detection system

(IDS) cannot directly detect intruders; it detects a variation in the condition being monitored, extracts characteristics of that variation, and assesses whether such a variation probably is caused by an intruder. However, exterior IDSs do not operate in a benign natural environment. Their environment is constantly changing as a result of solar-driven energy and moisture fluxes that create the weather. These weather changes often cause variations in the conditions being monitored by IDSs. The challenge, therefore, is to recognize how and when IDSs are responding to some change in their natural environment, rather than to intruders. This report is a technical analysis of causes of weather-driven temporal changes in the environment that impact the operational efficiency of IDSs. The report is intended to assist security designers in selecting suitable IDSs for a site and to assist security managers in operating IDSs at the required level of reliability. This is accomplished by identifying temporal variations in weather that are sufficiently general to be identified as patterns, and by identifying how different IDS phenomenologies respond to these patterns. The result is an understanding of how weather conditions influence the ability of types of IDSs to detect reliably activities representative of an intruder while successfully discriminating against weather-created conditions within a detection zone. The main body of the report is organized by temporal scale: diurnal, quasi-periodic, and seasonal. Within each temporal scale, weather processes common at that scale are explained. Topics covered include air and soil temperature, soil moisture, precipitation, snow cover, winds, fog, storms, urban and topographic effects, vegetation effects, and solar radiation.

CR 95-4**DEVELOPMENT AND APPLICATION OF A SPATIAL DATABASE FOR EMERGENCY MANAGEMENT OPERATIONS—1993 MIDWEST FLOOD.**

Nagle, J.A., Ochs, E.S., Bruzewicz, A.J., McKim, H.L., Mar. 1995, 57p., ADA-294 613, 8 refs.
49-5751

RIVER BASINS, FLOODING, GEOGRAPHY, MAPPING, GEOPHYSICAL SURVEYS, REMOTE SENSING, DATA PROCESSING, COMPUTER APPLICATIONS

During natural and man-made emergencies, there is a need for the rapid development of spatial databases to support recovery efforts. A spatial database was developed to support the U.S. Army Corps of Engineers Disaster Field Offices during the flooding in the midwest in the summer of 1993. The spatial database contains roads, railroads, hydrography, county boundaries and inundation data for 7 rivers located in the Mississippi River basin. The spatial data came from a variety of sources, including U.S. Census Bureau TIGER/Line files, U.S. Geological Survey Digital Line Graphs and satellite imagery. An application of the spatial database is also described. Maps were produced showing roads, railways, hydrography, county boundaries and, when available, inundation data. These maps were then distributed to assist in the recovery efforts and future planning.

CR 95-7**MOTION RESISTANCE OF WHEELED VEHICLES IN SNOW.**

Richmond, P.W., Mar. 1995, 47p., ADA-294 675, 12 refs.
49-5752

VEHICLE WHEELS, TIRES, TRACTION, SNOW MECHANICS, SNOW LOADS, SNOW DEFORMATION, ICE SOLID INTERFACE, COLD WEATHER PERFORMANCE, MECHANICAL TESTS, FORECASTING

Before vehicle mobility in snow can be reliably predicted, a complete understanding of motion resistance in snow is required. This report examines several aspects of wheeled vehicle motion resistance using results obtained with the CRREL instrumented vehicle. Resistances of leading and trailing tires are examined. Limited data are presented for undercarriage drag, and third and fourth wheel passes in the same rut are initially analyzed, as is the way snow deforms around a wheel. For the CRREL instrumented vehicle, a trailing tire has a resistance coefficient of about 0.017 for snow depths less than about 22 cm. For deeper snow, the disruption of the snowpack caused by a preceding wheel causes snow to fall into the rut, resulting in higher trailing tire coefficients. For larger vehicles, which in some cases have trailing tires carrying larger loads than preceding tires, the trailing tire coefficients are on the order of 0.048 and 0.025 for second and third trailing wheels respectively. The results and observations of this study are applied in a reanalysis of the towed resistance data obtained during the U.S. Army's Wheels vs. Tracks study. An improved algorithm is presented for predicting wheeled vehicle motion resistance caused by snow.

CR 96-01**MODEL ICE PROPERTIES.**

Zufelt, J.E., Ettrema, R., Feb. 1996, 19p., ADA-308 767, 35 refs.
50-5673

ICE MODELS, ICE PHYSICS, ICE JAMS, ICE STRENGTH

Physical modeling is often used to study complex ice processes when analytical formulations or numerical simulations fall short. Judicious choice and use of materials to model the ice in scaled experiments require knowledge of the properties of the material as well as an understanding of the dominant forces governing the process to be modeled. This report describes general similitude requirements for various modeling situations and the properties of several previous and currently used model ice materials.

CR 96-02**ICE ACCRETION IN FREEZING RAIN.**

Jones, K.F., Apr. 1996, 23p., ADA-310 659, 33 refs.
50-2245

RAIN, ICE STORMS, ICE LOADS, ICICLES, ICE ACCRETION, HEAT BALANCE, ICE MODELS, WIND FACTORS, HEAT FLUX, MATHEMATICAL MODELS, SOLAR RADIATION

Ice accreted on structures from freezing rain causes both increased vertical loads and increased wind loads, due to the larger projected area of the structure. Structural failures initiated by ice loads frequently cause millions of dollars of damage to overhead power and communication lines, towers, and other ice-sensitive structures. There is little information on ice loads to use in the design of these structures, so freezing-rain models have been developed for use with weather measurements to determine the severity of accreted ice loads from historical data. This report describes a detailed heat-balance ice accretion model, including the important heat fluxes in freezing rain and allowing the accretion of runoff water in the form of icicles. It also presents a simple algorithm for calculating the ice load on components with different diameters and cross sections. Collision efficiency in freezing rain and the calculation of the wind-on-ice load are also discussed. Model results are compared with the ice load measured during a recent freezing rain storm, and to each other, using 45 years of weather data from Des Moines, IA.

CR 96-03**NORTHERN SEA ROUTE: ITS DEVELOPMENT AND EVOLVING STATE OF OPERATIONS IN THE 1990S.**

Mulherin, N.D., Apr. 1996, 76p., ADA-310 144, Refs. p.59-62.
50-4960

ICE NAVIGATION, ICEBREAKERS, MARINE TRANSPORTATION, COST ANALYSIS, ECONOMIC ANALYSIS, PORTS, ICE CONDITIONS, SEA ICE, INTERNATIONAL COOPERATION, RUSSIA, RUSSIA—EAST SIBERIAN SEA, RUSSIA—KARA SEA, RUSSIA—LAPTEV SEA, NORTHERN SEA ROUTE, BARENTS SEA, CHUKCHI SEA

The summer of 1991 marked the first time in recent history that Russia offered to escort ships of other countries across the Northern Sea Route (NSR). For moving cargo between the North Pacific region and Northern European ports, the NSR along Russia's northern coastline is between 35 and 60% shorter than the traditionally used routes through the Suez and Panama Canals. In addition to its shorter distance, there already exists an extensive port and shipping infrastructure, a current cargo base, and the potential for developing new markets in Russia and other northern areas. These incentives are attracting considerable attention from the international shipping community, including that portion servicing Alaskan and northwestern U.S. ports. This report is a general compilation of the historical usage, recent trade developments, the current regulatory climate, the physical environment, the ports and navigational infrastructure, cost factors, and practical considerations that may shape future U.S. interests in the route.

CR 96-06**ELECTROMAGNETIC INDUCTION SOUNDING OF SEA ICE THICKNESS.**

Kovacs, A., Diemand, D., Bayer, J.J., Jr., June 1996, 8p., ADA-286 884, 13 refs.
50-4959

SEA ICE, ICE COVER THICKNESS, REMOTE SENSING, SOUNDING, ELECTROMAGNETIC PROSPECTING, COLD WEATHER PERFORMANCE, ELECTRICAL RESISTIVITY

Field results from a man-portable electromagnetic induction sounding instrument, with special plug-in data processing modules for the remote measurement of sea ice thickness, are discussed. The field trials indicate that the instrument was capable of estimating undeformed sea ice thickness, with a snow cover, generally within about 5% of the drill hole measured thicknesses from about 1.25 to 4.5 m. No ice under 1.25 m was sounded in this study. Instrument thickness determinations of multiyear sea ice over about 4.5 m thick showed larger deviation from the drill hole snow and ice thickness measurement. It is proposed that the undulating multiyear sea ice relief is the major cause of the EM deviation.

SPECIAL REPORTS

SR 90-20

EVALUATION OF A FIELD KIT FOR DETECTION OF TNT IN WATER AND SOILS.

Jenkins, T.F., Schumacher, P.W., June 1990, 14p., ADA-224 670, 12 refs.

45-192

DETECTION, EXPLOSIVES, MILITARY EQUIPMENT

Commercially available indicator tubes were evaluated for detection and measurement of TNT in water and soil. The tubes are intended for field use and can detect the presence of TNT in water and soil at concentrations as low as 40 micrograms/L and 0.5 micrograms/g respectively. Estimation of TNT concentration relies on measurement of stain length. Since the end point of the stain is diffuse, detecting the extent of stain length is very subjective. Therefore, it is imperative that standards and unknown samples be measured by the same analyst. Even when the same analyst makes all measurements, the accuracy and precision of concentration estimation is poor. Stain length was also found to depend on the sample matrix. Standards and samples must be matrix matched to enable proper calibration. Direct comparison of stain intensity, rather than length, to a standard at a criterion level successfully discriminated between standards with TNT concentrations above and below this level. The recommended soil extraction procedure using these indicator tubes was also evaluated. A 1-minute period of equilibration between soil and methanol resulted in incomplete TNT extraction. Percent recoveries were 58 to 70% of that achieved using a laboratory procedure involving an 18-hour equilibration period in a sonic bath. The percent extracted was directly related to the amount of TNT present in the soil.

SR 90-22

COMPLEX FORMATION BETWEEN DIMETHYL METHYLPHOSPHONATE AND HEXAFLUOROISOPROPANOL.

Leggett, D.C., June 1990, 3p., ADA-226 221, 8 refs.

45-191

MEASUREMENT, CHARGE TRANSFER

A solvent/water partitioning method was used to measure the complex formation between dimethyl methylphosphonate (DMMP) and hexafluoroisopropanol (HFIP). The highest formation constant was obtained when n-hexane was used as the partitioning solvent. Other solvents all interfered to some extent with complex formation, probably by interacting with HFIP. The log formation constant in carbon tetrachloride was 3.46 at 21 °C, which was similar to literature estimates for other phosphonates. The data support formation of H-bond charge transfer complexes as the mechanism for HFIP interaction with phosphonates and as primarily responsible for HFIP extraction of these compounds from water.

SR 90-24

THERMISTOR-BASED THERMAL CONDUCTIVITY MEASUREMENT SYSTEM.

Atkins, R.T., Wright, E.A., June 1990, 11p., ADA-226 278, 7 refs.

45-190

ANALYSIS (MATHEMATICS), MEASURING INSTRUMENTS, CONSTRUCTION MATERIALS, MEASUREMENT, THERMAL CONDUCTIVITY, THERMISTORS, SOILS

This report describes a patented method for using commercially available thermistors to make *in-situ* thermal conductivity measurements with commonly available electronic equipment such as digital voltmeters. The emphasis is on the use of a single thermistor to measure the thermal conductivity of soils. Calibration techniques are explained and examples provided. Limits on this technique are discussed, including measurement range, material grain size, the amount of material needed for a valid measurement, and temperature stability. Specific examples of the use of this technique are provided for thermal conductivity measurements of soils, building materials, and the sludges in a sewage treatment plant. Data analysis is provided, including a statistical approach to finding the thermal conductivity in large volumes of material.

SR 43/8

ICE THICKNESS OBSERVATIONS; NORTH AMERICAN ARCTIC AND SUBARCTIC, 1972-73 AND 1973-74.

Billelo, M.A., Bates, R.E., Dec. 1991, 127p., ADA-250 830, 4 refs.

46-4002

LAKE ICE, RIVER ICE, ICE CONDITIONS, SEA ICE, ICE COVER THICKNESS, ICE BREAKUP, FREEZEUP, ICE FORMATION, ICE REPORTING

This eighth in a series of reports on lake and river ice and land-fast sea ice presents ice thickness measurements observed throughout the North American arctic and subarctic during the 1972-73 and 1973-74 winter seasons. Information on surface ice conditions, dates of first ice, freeze-over and breakup, and detailed measurements of ice thickness across Alaskan rivers are also included. Some reports

from the Alaska National Guard network on ice thickness measurements in remote areas of western Alaska are also presented. Analyses were made of maximum observed ice thicknesses reported during the two winters, and isoline maps that show the areal distribution of these values across Canada and Alaska were drawn.

SR 82-29

COLD WEATHER CONSTRUCTION MATERIALS PART 2: FIELD VALIDATION OF LABORATORY TESTS ON REGULATED-SET CEMENT FOR COLD WEATHER CONCRETING.

Houston, B.J., Hoff, G.C., Sayles, F.H., Dec. 1982, 27p., ADA-124 526, 6 refs. For another version see 36-1028.

45-3475

CONCRETE CURING, CONCRETE STRENGTH, CHEMICAL COMPOSITION, COLD WEATHER CONSTRUCTION, CONCRETE PLACING, CONSTRUCTION MATERIALS, CEMENTS, CONCRETE ADMIXTURES, COLD WEATHER TESTS

The Army carries on construction projects in localities where the concrete placing season is shortened considerably by the cold climate. This study evaluates "regulated-set" cement, which is a fast setting, rapid strength gain cement, that appeared to have great promise and would allow concrete to be placed at ambient temperatures as low as 15 °F. Both mortars and concretes made with regulated-set cement were studied in the laboratory with favorable results, so the laboratory results were validated with field testing. Two test slabs were cast when the mean ambient temperature was approximately 15 °F. The only differences in the two slabs were the concrete mixture temperature and air entrainment, and the slabs received no special protection from the ambient temperatures. Neither slab obtained any appreciable compressive strength at 1 day but slab 1 had approximately 1200 and 2000 psi at 7 and 28 days, respectively, while slab 2 had 2200 and 3300 psi, respectively. Since there was no strength gain at day 1, whereas there had been in laboratory tests of approximately the same concrete mixture but with an earlier shipment of regulated-set cement, a sample of the cement from the field test was brought to the laboratory for comparison with the cement used in the laboratory tests. Chemical and physical tests indicated that there was a difference in chemical composition; the laboratory shipment had a higher sulfate content. This difference points out the need for a responsive purchase specification, which is presently not available.

SR 84-16

CATALOG OF SMOKE/OBSCURANT CHARACTERIZATION INSTRUMENTS.

O'Brien, H.W., ed., Bowen, S.L., ed., June 1984, 184p., For another version see 39-2950.

45-3476

RADIOMETRY, SNOW CRYSTAL STRUCTURE, SNOW COMPOSITION, MILITARY RESEARCH, TEST EQUIPMENT, RADIATION MEASURING INSTRUMENTS, RECORDING INSTRUMENTS, LIGHT TRANSMISSION, AEROSOLS, SCATTERING, ATMOSPHERIC COMPOSITION, METEOROLOGICAL DATA

A survey of field test instrumentation that is currently used by DOD agencies and their civilian contractors to characterize smokes, dust and debris, and natural obscuration has been carried out by the U.S. Army Cold Regions Research and Engineering Laboratory for the Project Manager for Smoke/Obscurants. The results of the survey are compiled in this catalog. The catalog includes instruments that directly measure, or through some computation lead to the generation of data relating to: 1) luminance and radiance, 2) transmittance or attenuation, 3) airborne-obscurant particle size and concentration, 4) cloud mechanics, and 5) meteorological parameters. It also provides information concerning instrumentation for appropriate 6) data acquisition and processing, and 7) documentation or other special-purpose information.

SR 90-03

LABORATORY COMPARISON OF FIELD TECHNIQUES FOR MEASUREMENT OF THE LIQUID WATER FRACTION OF SNOW.

Boyne, H.S., Fisk, D.J., Feb. 1990, 8p., ADA-219 587, 8 refs.

45-560

SNOW WATER CONTENT, MEASUREMENT

The amount and distribution of liquid water in a snow cover is important for assessing its mechanical strength, meltwater generation and meltwater transmission. It also has a profound effect on the performance of active and passive remote sensing systems operating in the microwave and millimeter wave regions of the electromagnetic spectrum. New methods of measuring liquid water have been reported that show considerable promise. This report describes tests of measurement equivalence, in which are compared the three absolute methods of freezing calorimetry, alcohol calorimetry and dilution.

Also compared are a capacitance snow moisture meter and one of the absolute methods. All comparisons were made in a laboratory cold-room using homogeneous snow with a mass liquid water content that varied from 0 to 14%. The comparisons show that the methods are equivalent and that the experimental errors associated with the measurements are consistent with what is expected from an error analysis of each method. However, the operational achievement of equivalence depends strongly on a variety of factors such as sample size, mixing of snow and working fluid, and operator skill.

SR 90-14

ICE FORCES ON FLAT, VERTICAL INDENTORS PUSHED THROUGH FLOATING ICE SHEETS.

Nakazawa, N., Sodhi, D.S., May 1990, 62p., ADA-223 420, 37 refs.

45-937

PENETRATION TESTS, IMPACT TESTS, ICE LOADS, ICE COVER STRENGTH, ICE CRACKS, CRACKING (FRACTURING)

Structures placed in an ice environment should be able to withstand the ice forces that are produced by the motion of a floating ice sheet. To observe the crushing failure of ice and to characterize the magnitude and nature of ice forces, an experimental study was conducted by pushing vertical, flat indentors through floating ice sheets made up of freshwater, columnar ice. Depending on the velocity of the indentor, ductile or brittle behavior of ice was observed. Microcracks and macrocracks were observed during the tests. The energy used to produce the maximum ice force was found to be approximately the same for different indentor velocities. The positions of the resultant forces were found to be in the center of the contact area. The area of the ice damaged by the first peak loading of the indentor was about the same, even when the indentor velocities were different. Acoustic emission signals were measured during indentation experiments, and these were found to correlate with the ice force that produces strain and microcracking in the ice.

SR 90-16

PURITY DETERMINATION OF STANDARD ANALYTICAL REFERENCE MATERIALS BY DIFFERENTIAL SCANNING CALORIMETRY.

Black, P.B., Pidgeon, D.E., May 1990, 6p., ADA-224 669, 11 refs.

45-90

TEMPERATURE MEASUREMENT, MATERIALS, TESTS, MILITARY RESEARCH

As part of the United States Army Toxic and Hazardous Materials Agency (USATHAMA) Quality Assurance program to maintain a set of high-purity (>98 mol%) Standard Analytical Reference Materials (SARMs), the SARMs' purity must be routinely monitored. This report presents data on melting temperature, freezing point depression and heat of fusion as measured by differential scanning calorimetry (DSC) for the seven SARMs suited to DSC methods. These data were then used in the van't Hoff's equation to determine each munition standard's molar purity. The purity of each tested SARM was greater than 98 mol%, which confirmed the integrity of the SARMs.

SR 90-18

FENCE CHARACTERIZATION FOR INTRUSION DETECTION SYSTEMS.

Walsh, M.R., Peck, L., May 1990, 23p., ADA-223 564, 2 refs.

45-98

EQUIPMENT, TESTS

Equipment and test procedures for quantifying the normal stiffness, transverse stiffness, post rigidity and post plumbness of a chain-link fence are described. These parameters characterize the condition of the fence and determine its suitability for use with a fence-mounted intrusion detection system.

SR 90-19

MICROWAVE DIGESTION OF SOILS AND SEDIMENTS FOR ASSESSING CONTAMINATION BY HAZARDOUS WASTE METALS.

Hewitt, A.D., Reynolds, C.M., June 1990, 14p., ADA-226 367, 26 refs.

49-292

MICROWAVES, METALS, SEDIMENTS, SOIL POLLUTION

This report compares results obtained for the metals extracted with a microwave-nitric acid digestion technique to results obtained by procedure R9, a soil-sediment hot-plate digestion method certified by the United States Army Toxic and Hazardous Materials Agency (USATHAMA). In addition, microwave-nitric acid digestions were performed on a National Institute of Standards and Technology (NIST) environmental reference river sediment standard SRM-2704. Compared to existing protocols using hot-plate digestions, the microwave-heated-acid extraction of metals from soils and sedi-

ments is faster, more easily field implemented, and less subject to technician error. For Rocky Mountain Arsenal (RMA) standard soil, the average relative recoveries of Ba, Cu, Hg, Ni and Zn contained in the microwave-HNO₃ digest were within 16%, and Pb and Cr levels within 30% of the values reported by a contract laboratory using USATHAMA digestion procedure R9. Moreover, average recoveries of analytes spiked onto the RMA standard soil were greater than 90% for Ag, Ba, Cd, Cu, Cr, Hg, Ni, Pb, Se, Ti and Zn. In addition, average recoveries greater than 94% of NIST certified values were obtained for As, Cd, Cu, Pb, Ti and Zn from the standard reference material SRM-2704, Buffalo River sediment. This microwave digestion procedure appears to be suitable for the extraction of both volatile and nonvolatile metals from hazardous-waste-contaminated soils and sediments.

SR 90-21 SOLVENT/WATER PARTITIONING AND EXTRACTION OF DIMETHYL METHYLPHOS- PHONATE: IMPORTANCE OF HYDROGEN- BONDING.

Leggett, D.C., June 1990, 6p., ADA-226 541, 21 refs.
49-290

WATER POLLUTION, GROUND WATER, HYDROGEN BONDS

Partition coefficients for dimethyl methylphosphonate (DMMP) between water or salt-saturated water and 28 organic solvents were measured. On the average the solvents extracted 7 times as much DMMP from sodium chloride-saturated water as from distilled water. The highest partition coefficients were with H-donor solvents, especially the fluorinated alcohols, trifluoroethanol and hexafluoroisopropanol. Partition coefficients for these solvents and salt-saturated water were 150 and >260, respectively. These results indicate that DMMP can be extractively preconcentrated >100-fold from water with an appropriate choice of solvent and addition of excess sodium chloride. Since DMMP is the lowest homolog of the phosphonate series, higher members are expected to have higher partition coefficients because of greater hydrophobic contributions. The principal mechanism driving extraction appears to be formation of H-bond donor-acceptor complexes which are preferentially solvated by the solvent.

SR 90-23 EVALUATION OF PVDF PIEZOPOLYMER FOR USE AS A SHOCK GAUGE.

Dutta, P.K., Kalafut, J., June 1990, 11p., ADA-225 955, 7 refs.
46-2921

POLYMERS, SHOCK WAVES, STRESSES, FROZEN
GROUND MECHANICS, MEASURING INSTRUMENTS
Polarized polyvinylidene fluoride film (PVDF) is a unique piezoelectric material with a very high sensitivity to shock pressure. It is also highly pliable. A large number of shock gauges were fabricated using this material; they were then calibrated and evaluated in the Split Hopkinson Pressure Bar Apparatus. Shock waves of defined geometry were passed through these test gauges and their responses were measured. Application of these gauges is foreseen in ground shock measurements where stress perturbations because of gauge inclusion in the media have to be minimized. This report discusses the development, construction and evaluation of these gauges.

SR 90-25 FREEZE-THAW TESTS OF FULL-SCALE ROLLER-COMPACTED CONCRETE TEST SEC- TIONS.

Cortez, E.R., Eaton, R.A., July 1990, 14p., ADA-228 577, 13 refs.
46-5073

FREEZE THAW TESTS, FROST RESISTANCE, COLD
WEATHER PERFORMANCE, CONCRETE PAVEMENTS,
CONCRETE DURABILITY, CONCRETE FREEZING

SR 90-26 ANALYSIS OF WINTER LOW-FLOW RATES IN NEW HAMPSHIRE STREAMS.

Melloh, R.A., Aug. 1990, 12p., ADA-229 512, 11
refs.

45-1260

RUNOFF, DRAINAGE, STREAM FLOW, SEASONAL VARI-
ATIONS, WINTER, FLOW RATE, CLIMATIC FACTORS,
STREAMS

The timing and magnitude of winter low flows vary regionally in response to basin climate and geology. This report investigates the regionalization of low flows in the White Mountain and Upland physiographic sections of New Hampshire to establish a data set that will be used in improved analytical methods for estimating winter flows. For the summer and winter low flow periods, 3-, 7-, 14- and 30-day duration low flow events are estimated for various sizes of drainage areas (50 to 230 square miles). The likelihood of a low-flow event increases as winter proceeds in the White Mountains, but is more evenly distributed throughout the winter in the Upland. White Mountain streams have higher runoff volumes through all seasons, except winter. The average magnitudes of winter low-flow events in both physiographic sections are highly correlated with drainage area size. Mean basin elevation was of little additional help in explaining winter low-flow events within either physiographic section, though it was important in explaining summer low-flow variation in the White Mountains.

SR 90-27 IN-SITU DETECTION OF CONTAMINANT PLUMES IN GROUND WATER.

Seitz, W.R., Aug. 1990, 12p., ADA-228 409, 53 refs.
45-935

HYDROCARBONS, IONS, GROUND WATER, WATER POL- LUTION, SPECTROSCOPY

Ground-water contaminants can be detected in situ by making spectroscopic measurements through fiber optics. In addition to direct measurements, it is possible to couple fiber optics with chemical indicators that interact with the contaminants to enhance their detectability. Direct fluorescence measurements have been used to sensitively detect aromatic hydrocarbons in fossil fuels. Direct Raman measurements are also possible but can only detect relatively high concentrations (greater than 0.1%). Parts per billion levels of nitroaromatics and halogenated hydrocarbons can be detected using indicators that react to form colored products. The rate at which the absorbance of the colored product increases is proportional to concentration. Refractive index measurements offer a rugged reversible approach to detecting organic contaminants in the low parts per million range. All of these techniques require further development before they can be reliably used on a routine basis. Other spectroscopic techniques are considered in the report, but are not considered ready for in-situ ground-water monitoring at this time.

SR 90-28 COMPARISON OF TEST METHODS FOR DETERMINATION OF FLEXURAL STRENGTH IN UREA MODEL ICE.

Borland, S.L., Aug. 1990, 9p., ADA-227 781, 12 refs.
45-840

UREA, ICE MODELS, FLEXURAL STRENGTH, ICE STRENGTH

Laboratory tests were performed in a basin to compare the flexural strength of urea ice obtained by three different beam test methods. The beam test methods used were the *in-situ* three-point loaded simple beam test, the out-of-water three-point loaded simple beam test and the *in-situ* cantilever beam test. There is essentially no difference in flexural strength determined from either of the three-point beam tests, and the flexural strength obtained from either of the three-point beam tests is also approximately equal to the value determined from the *in-situ* cantilever beam test. A reduction in flexural strength with increases in beam length-to-thickness ratio was observed for portions of the data set.

SR 90-29 MODEL STUDY OF THE CAZENOVIA CREEK ICE CONTROL STRUCTURE.

Gooch, G.E., Deck, D.S., Aug. 1990, 31p., ADA-228 032, 8 refs.
45-934

ICE CONTROL, ICE JAMS, ICE PREVENTION, FLOOD CONTROL, ICE MODELS

An ice control structure was chosen as a solution to ice-jam flooding of the business and residential communities of West Seneca and Buffalo, New York, along Cazenovia Creek. A model study was proposed to evaluate its performance before actual construction. This report describes the design, execution, and results of the model study, which led to the eventual acceptance of the proposed ICS by the U.S. Army Engineer District, Buffalo.

SR 90-30 SALTING-OUT SOLVENT EXTRACTION METHOD FOR DETERMINING LOW LEVELS OF NITROAROMATICS AND NITRAMINES IN WATER.

Miyares, P.H., Jenkins, T.F., Aug. 1990, 26p., ADA-227 761, 6 refs.
45-663

WATER CONTENT, GROUND WATER, WATER POLLU- TION, EXPLOSIVES

A protocol was developed for determining low levels of nitroaromatics and nitramines in ground water. Sample preparation employs salting-out extraction with acetonitrile and NaCl, further preconcentration of extract by solvent evaporation on a Kuderna-Danish concentrator, dilution of the concentrate with water, and filtration through a 0.5 micron Millex-SR filter. Separation is achieved using reversed-phase high-performance liquid chromatography with an LC-8 (3.3 cm) column using a 70/727.8/1.5 (v/v/v) water-methanol-THF eluent, and determination is obtained on a UV detector at 254 nm. This procedure provides far lower detection limits than the earlier protocol, which involved direct injection onto an LC-18 (25 cm) column eluted with 50/50 (v/v) methanol-water. The new method is capable of simultaneously determining RDX, TNB, DNB, TNT, 2,4-DNT, 2,6-DNT, 2-Am-DNT and 4-Am-DNT in less than five minutes, with reporting limits ranging from 0.02 to 0.84 microgram/L. Analytical recovery averaged greater than 95%.

SR 90-31 ENVIRONMENTAL INFLUENCES ON MINE DETECTION.

Hogan, A.W., Leggett, D.C., Lacombe, J., Aug. 1990, 6p., ADB-149 274, 16 refs.
45-933

ANALYSIS (MATHEMATICS), MINES (ORDNANCE),
DETECTION, VAPOR TRANSFER, EXPLOSIVES, MILI-

TARY OPERATION

Research has been conducted to determine the probable influence of the environment on the operational use of chemical vapor "sniffing" devices for standoff mine detection. Experiments indicate that the external surfaces of mines become contaminated with TNT during storage and that this contamination provides a strong vapor source, detectable by several types of sniffing devices. A model calculation is performed to determine the TNT vapor generated by a "standard" minefield pattern. This calculation, carried out over the several Pasquill categories, estimates the source strengths of TNT vapor emanating from contaminated mine surfaces at 100-m horizontal distance from the minefield. Additional operational meteorological problems that need to be solved relate to airborne or ground platforms to carry the sniffing devices, and possible rates of advance consistent with varying meteorological conditions.

SR 90-32 ANTIFREEZE ADMIXTURES FOR COLD REGIONS CONCRETING: A LITERATURE REVIEW.

Korhonen, C.J., Sep. 1990, 14p., ADA-228 560, 35
refs.

45-974

WINTER CONCRETING, CONCRETE ADMIXTURES, ANTIFREEZES

Winter concreting practices in the U.S. are geared toward assuring that chemical admixtures can be used to depress the freezing point of mix water, thereby allowing cement to hydrate at below-freezing temperatures. With these admixtures, strength gain at low temperature lags that of additive-free concrete at room temperature, but nevertheless, strength gain is significant. Though questions still remain on the short- and long-term effects of these admixtures on concrete, they appear to offer an economical alternative to conventional concreting practices.

SR 90-33 HIGHWAY SNOW CONTROL RESEARCH IN JAPAN.

Itagaki, K., Sep. 1990, 60p., ADA-228 937, 129 refs.
45-999

RESEARCH PROJECTS, SNOW MELTING, SNOW FENCES, SNOW REMOVAL, ROAD MAINTENANCE, ARTIFICIAL MELTING, JAPAN

The wide range of Japanese efforts to control snow and ice on highways is reviewed. Many studies parallel U.S. and European research, but extensive basic studies of applications of modern high technology are noted as well.

SR 90-34 IN-HOUSE LABORATORY INDEPENDENT RESEARCH PROGRAM—FY88.

Diemand, D., ed, Moritz, M., ed, Oct. 1990, 18p.,
ADA-229 665.

45-1399

RESEARCH PROJECTS, ICE, SNOW, FROZEN GROUND
CRREL's In-House Laboratory Independent Research (ILIR) Program provides a means for innovative high-risk basic research. This report briefly describes the 17 ILIR research projects undertaken in FY88. Work in this program addressed various problems concerning the physical properties of ice, snow and frozen ground; remote sensing of lake and river ice; water content of frozen or partially frozen materials; and physical/mathematical models for experimental or predictive use in ice research.

SR 90-35 LABORATORY AND FIELD TESTS OF A WIRE MESH FRAZIL COLLECTOR.

Foltyn, E.P., Oct. 1990, 10p., ADA-230 181, 9 refs.
45-1511

FRAZIL ICE, RIVER ICE, ICE CONTROL, DESIGN, FLOODING

Frazil ice jams on rivers cause problems that range from slowing commercial river traffic to widespread flooding. Through the years, one of the accepted techniques of controlling frazil ice jams has been to retain the frazil ice in a location where it will not harm the environment, using dams or weirs. In the interest of developing an inexpensive ice control structure, a series of laboratory and field tests were conducted using different wire mesh structures as a dam to determine which type of wire mesh best retains ice and what the optimum orientation of that mesh should be. A material such as chain link fence fabric would collect and retain the ice, but proper bed preparation must be done to prevent bed scour. Further study is required to determine the optimum mesh size.

SR 90-36 SCHEDULING FALL SEEDINGS FOR COLD- CLIMATE REVEGETATION.

Racine, C.H., Bailey, R.N., Palazzo, A.J., Oct. 1990,
6p., ADA-229 742, 10 refs.

45-1664

DEGREE DAYS, GROWTH, REVEGETATION, GRASSES
Revegetating construction sites in the fall requires the scheduling of seeding and mulching for either permanent or dormant seedings. Dormant seedings must be late enough in the fall to prevent germination, while permanent seedings must be early enough to permit seedling establishment and avoid winterkill. A technique for

determining optimum seeding dates using growing degree-day curves was developed and tested. Small outdoor plots and buried pots in Hanover, NH, were seeded with tall fescue at intervals during Oct. 1988 and 1989, respectively, and covered with either straw mulch or a Typar row cover. Soil surface temperatures, germination and growth were monitored into the following springs. Fall or spring germination of fall-sown tall fescue seeds required about 100 GDDs (growing degree days) (over 5°C), while the development of a second leaf required an additional 70 GDDs. In the experimental plots without any cover, these requirements were met with Oct. 12 and Oct. 5 seedlings, respectively; with a Typar cover, seeding dates could be delayed by one week. In pots the greatest spring yields were obtained under Typar at the earliest (5 Oct.) seeding date and the latest dormant seeding date (2 Nov.). Straw mulch applied during the fall had little or no effect on the number of growing degree-days remaining. However, during the following spring, it slowed soil warming and germination of dormant seedlings. The appropriate fall seeding date for northern areas can be calculated using a power curve for Hanover, NH: Julian date = $360 \times (\text{GDDs required})^{\exp -0.05}$.

SR 90-37
COLD TOLERANCE OF PLANTS USED FOR COLD-REGIONS REVEGETATION.
 Reid, W.H., Palazzo, A.J., Oct. 1990, 15p., ADA-229 864, Refs. p.9-15.
 45-1433
 REVEGETATION, PLANTS (BOTANY), COLD TOLERANCE

Only a fraction of the world's plant species can tolerate freezing, and all exhibit various forms of damage after exposure to extreme cold. Some species, on exposure to low, nonfreezing temperatures, exhibit enhanced tolerance through a genetically determined process called cold hardening. Cold tolerance is attributed partly to the accumulation of soluble carbohydrates, soluble proteins and lipids in cells, and to the proliferation of intracellular membranes. There are several methods of testing for cold tolerance. Plant nutritional status may increase or decrease cold tolerance. Several chemicals, among them a fungicide, have been found to reduce cold tolerance. Water stress improves cold tolerance. Research is needed in several areas to improve the success and lower the cost of revegetation projects. The genetics of cold tolerance is poorly understood. Research on cold tolerance with combined stresses is needed. Simulation analysis of plant growth in cold climates is important if carbon balance is to be understood. Applied research is needed in several areas: appropriate statistical descriptions of climate, remote sensing for terrain evaluation, analysis to determine plant and soil temperatures in relation to air temperature; and complex revegetation strategies involving plant succession on disturbed lands. Cold-regions soil microbiology, important in plant success, is poorly known. A clearing house for information on plant cold tolerance and cold-regions revegetation would reap great reward for efficient reclamation.

SR 90-38
DEVELOPMENT OF A SIMPLIFIED FIELD METHOD FOR THE DETERMINATION OF TNT IN SOIL.
 Jenkins, T.F., Nov. 1990, 18p., ADA-230 182, 1 ref.
 45-1586
 EXPLOSIVES, SOIL POLLUTION, GROUND WATER, MILITARY OPERATION

A simple field method was developed for determining the concentration of 2,4,6-trinitrotoluene (TNT) in soil. The method involves extraction of the soil with acetone, generation of the red-colored Jackson-Meisenheimer anion by addition of potassium hydroxide and sodium sulfite, and measurement of color intensity at 540 nm using a battery-operated spectrophotometer. The method was shown to follow the Beer-Lambert law with linear calibration through an absorbance of 0.9 absorbance units, and was found to be both precise and accurate in tests with spiked soils, providing a detection limit of about 1 microgram/gram. The extraction step recovered a mean of 96% of the TNT recoverable by a more exhaustive laboratory extraction procedure. A comparison was made of concentration estimates from the field method with those from the standard RPHPLC laboratory procedure using a set of field-contaminated soils. An excellent correlation existed between the two when both 1,3,5-trinitrobenzene and TNT concentrations from the laboratory measurements were included. The method is susceptible to interference from a number of polynitroaromatic compounds including the following: 1,3,5-trinitrobenzene (red), tetryl (orange), 2,6-dinitrotoluene (pinkish purple), 2,4-dinitrotoluene (blue) and 1,3-dinitrobenzene (purple). No color was observed for nitramine explosives, such as RDX or HMX, or nitrate esters such as nitroglycerine or pentaerythritol tetranitrate. The method was field tested at Umatilla Army Depot and found to provide a simple, rapid method for estimating TNT concentrations in the field. Concentration estimates from field analysis correlated well with laboratory analyses of the same samples.

SR 90-39
MODELING ICE PASSAGE THROUGH SUBMERGIBLE AND NON-SUBMERGIBLE TAITER GATES.
 Gooch, G.E., Rand, J.H., Hanamoto, B., Zufelt, J.E., Nov. 1990, 75p., ADA-231 358.
 46-5123

ICE NAVIGATION, SPILLWAYS, SLUICES (HYDRAULIC ENGINEERING), HYDRAULIC STRUCTURES, MODELS, LOCKS (WATERWAYS), ICE CONTROL

In the cold regions of the U.S., ice accumulation in the approach area

of navigation locks has been a constant problem. This ice is often pushed into the lock ahead of a towboat, sometimes requiring a separate lock cycle. This reduces the efficiency of the lock and slows down ship traffic. By modeling this problem and testing the solution to it, the research team has been able to conclusively show that submergible tainter gates located near the approach will solve the above-mentioned ice problems.

SR 90-40
ICE FORMATION IN FREQUENTLY TRANSITED NAVIGATION CHANNELS.

Ettema, R., Huang, H.P., Dec. 1990, 110p., ADA-232 115, 48 refs.

45-1972

ICE GROWTH, ICE MODELS, MATHEMATICAL MODELS, SHIPS, RIVER ICE, ICE NAVIGATION, ICE FORMATION, CHANNELS (WATERWAYS)

Results are reported of a study aimed at determining and documenting the effects of frequent vessel transit on ice-cover formation over navigation channels. A practical objective of this study was to evaluate the merits of scheduling vessel transits as a means of mitigating problems caused by transiting of ice-covered channels. Vessels transiting through ice covers lead to increased ice growth and transform ice to brash ice, which collects in thick accumulations that may halt traffic. The study entailed extensive laboratory experiments conducted with an ice tank and model hulls that simulated river tows and ships. It also included the formulation and use of a numerical model of ice formation. Another brief study examined the mechanics of ice accumulation beneath flat-bottomed tows. The results from the ice-tank experiments and the numerical model indicate that, except for convoys of vessels, the problems incurred by frequent transiting are not readily mitigated by a sophisticated transiting schedule. Convoys does hold promise of reducing the severity of the problem because it reduces the number of icebreaking transits. Of greater promise, however, is an approach involving mechanical methods for controlling brash-ice accumulations at perennially difficult channel locations.

SR 90-41
SADARM CAPTIVE FLIGHT TESTS: DATA REPORT.

Boyne, H.S., et al, Dec. 1990, 104p., 5 refs.

49-298

DATA PROCESSING, RADAR, SENSORS, MILITARY OPERATION, COLD WEATHER PERFORMANCE, ACCURACY, ELECTROMAGNETIC PROSPECTING

Winter captive flight tests were conducted in Feb. and Mar. 1990 in Grayling, MI, which, along with ground-based sensor measurements, provided data for evaluating the sensor systems under development and increasing understanding of target-background interaction. These data are essential for an objective analysis of probabilities of detection and false alarm rates. The program documented the environmental conditions encountered during the test period, determined how the winter environment affects seeker-sensor performance, and developed a comprehensive data set of the background scene for use in modeling the electromagnetic response in a cold regions environment. Hypotheses of winter background conditions that would have a significant effect on sensor performance were developed and measurements were made to test these hypotheses and document the background-sensor performance.

SR 90-42
CRREL RESEARCH ON MATERIALS IN COLD ENVIRONMENTS.

Dutta, P.K., Dec. 1990, 20p., ADA-232 133, 35 refs.
 45-2002

LOW TEMPERATURE TESTS, MATERIALS, COLD WEATHER PERFORMANCE, TENSILE PROPERTIES, LOW TEMPERATURE RESEARCH

This report is a synopsis of the developments in the materials research program at CRREL. Focusing on studies of the low-temperature behavior of materials, the report reviews these developments in three specific areas: creating a materials-property data base, researching composites and other materials and developing test facilities. Among materials, composites, being newer, have been studied in depth. Temperature and strain rate have been considered critical in influencing any material's durability; therefore, facilities were developed to provide precise control of these parameters. The program aims to meet the crucial need for designing structures and equipment using materials specifically adapted for cold regions and low-temperature applications.

SR 90-43
ICE JAM ANALYSIS AT IDAHO FALLS, SNAKE RIVER, IDAHO.

Zufelt, J.E., Earickson, J.A., Cunningham, L., Dec. 1990, 18p., ADA-232 226, 4 refs.

45-2035

FRAZIL ICE, ICE CONTROL, ICE JAMS, FLOODING, HYDRAULICS, UNITED STATES—IDAHO—SNAKE RIVER

SR 90-44
PROCEEDINGS OF THE 47TH ANNUAL EASTERN SNOW CONFERENCE, BANGOR, ME, JUNE 7-8, 1990.

Eastern Snow Conference, Ferrick, M.G., ed, Pangburn, T., ed, 1990, 250p., ADA-233 320, Refs. passim. For selected papers see 45-2182 through 45-2203.

45-2181

SNOW AIR INTERFACE, ICE COVER STRENGTH, SNOW WATER EQUIVALENT, SNOW SURVEYS, RUNOFF, SNOWFALL, SNOW COVER, SNOWMELT, LAKE EFFECTS, RIVER ICE, MELT WATER

SR 91-01
MEMBRANE FOR IN-SITU OPTICAL DETECTION OF ORGANIC NITRO COMPOUNDS BASED ON FLUORESCENCE QUENCHING.

Seitz, W.R., Jian, C., Sundberg, D.C., Jan. 1991, 10p., ADA-244 261, 12 refs.

46-1864

EXPLOSIVES, DETECTION

Quenching of emission from fluorescent membranes was evaluated for detecting organo nitro compounds used as explosives. The most sensitive membrane is prepared using solvent casting from cyclohexanone to incorporate pyrenebutyric acid into cellulose triacetate plasticized with isodecylidiphenyl phosphate. The response appears to follow the Stern-Volmer law for TNT and DNT. The membrane also responds to RDX, but with less sensitivity. Detection limits are approximately 2 ppm for DNT and TNT and 10 ppm for RDX. Attempts were made to adapt the membrane for remote in-situ measurements. In this context, the extent of quenching needs to be determined from the decrease in fluorescence lifetime because this type of measurement is fairly impervious to drift and interference. Fluorescence intensities were measured remotely through fiber optics; however, this was only done when the load resistance in the detection circuit was large, such that the fluorescence decay reflected the RC time constant of the detection electronics rather than the fluorescence lifetime.

SR 91-02
SEA ICE OBSERVATIONS FROM THE WINTER WEDDELL GYRE STUDY-89.

Meese, D.A., et al, Feb. 1991, 161p., ADA-236 036, With map notations in Russian.

45-2903

MAPS, SEA ICE, ICE COVER THICKNESS, ICE CONDITIONS, ICEBERGS, ANTARCTICA—WEDDELL SEA

The data for this report were obtained during the Winter Weddell Gyre Study-89 from the Soviet icebreaker *Akademik Fedorov*. This study took place between Sep. and Nov. 1989 in the Weddell Sea. Several times each day throughout the cruise, notes were taken on the ice conditions that the ship was passing through at that time. These notes included ice concentration, thickness, ice type, amount of ridging, number of icebergs in the area and other distinguishing characteristics. In addition, photos of the area were taken and are included in the next section. The following section includes detailed ice observations maps. These maps contain information for every mile of ice that was passed through during the cruise, including ice thickness, type and concentration; iceberg size, number and type; and the extent and size of leads. Every 30-60 miles during the cruise stops were made at ice stations where ice cores and water samples were taken for physical and chemical studies, ice thickness grids were drilled, and optical measurements were made. At each site an ice map of the station was compiled, including wind direction and speed, air temperature, ice type, ice thickness and other characteristics of the area. Copies of these maps are found in the *Ice Station Maps* section. Also presented here are daily satellite photos of the area the ship was traversing. Throughout the cruise these photos provided the ship's crew with information regarding ice conditions that the ship would be encountering. The final section consists of weekly ice extent maps of the Weddell Sea obtained from the National Oceanographic and Atmospheric Administration. This report contains a complete observational analysis of the ice conditions encountered during this study in the Weddell Sea. (Auth. mod.)

SR 91-03
IN-SITU HEAT FLUX MEASUREMENTS IN BUILDINGS; APPLICATIONS AND INTERPRETATIONS OF RESULTS.

Flanders, S.N., ed, Feb. 1991, 260p., ADA-234 924, Refs. passim. Papers presented at the Workshop on In-Situ Heat Flux Measurements in Buildings, Hanover, NH, May 22-23, 1990. For individual papers see 45-2649 through 45-2662.

45-2648

BUILDINGS, HEAT FLUX, TEMPERATURE MEASUREMENT, THERMAL INSULATION, THERMAL CONDUCTIVITY

SR 91-04
COMPARISON OF HEADSPACE GAS CHROMATOGRAPHY WITH EPA SW-846 METHOD

8240 FOR DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN SOIL.

Hewitt, A.D., Miyares, P.H., Leggett, D.C., Jenkins, T.F., Feb. 1991, 7p., ADA-235 497, 13 refs. 45-2826

SOIL POLLUTION, SOIL CHEMISTRY, CHEMICAL ANALYSIS, WASTE TREATMENT

This study compares the levels of volatile organic compounds (VOCs) in a laboratory-prepared soil as determined by headspace gas chromatography and the EPA SW-846 purge and trap gas chromatography/mass spectrometry method (Method 8240). Vapor exposure was chosen as the method of contaminating the soil with trans-1,2-dichloroethylene, benzene, trichloroethylene and toluene. Preliminary results showed that the concentrations of the four compounds determined by the two analytical procedures were not significantly different at the 95% confidence interval for two levels of contamination. These findings indicate that headspace gas chromatography may have significant potential for hazardous waste assessment and cleanup programs.

SR 91-05 INTERNATIONAL STATE-OF-THE-ART COLLOQUIUM ON LOW-TEMPERATURE ASPHALT PAVEMENT CRACKING.

Scherocman, J.A., Feb. 1991, 50p., ADA-233 663, 45 refs.

46-4463

BITUMENS, LOW TEMPERATURE RESEARCH, COLD WEATHER PERFORMANCE, PAVEMENTS, CRACKING (FRACTURING), BITUMINOUS CONCRETES, BIBLIOGRAPHIES

The International State-of-the-Art Colloquium on Low-Temperature Asphalt Pavement Cracking was held in Hanover, NH, on May 6-8, 1987. The objective was to review and summarize the existing knowledge of the causes of low-temperature transverse cracking of asphalt concrete pavement. Discussion also suggested directions for future research needed to more fully understand the mechanisms of low-temperature cracking. Overlays were not discussed.

SR 91-06 THERMAL CONDUCTIVITY OF POROUS MEDIA AND SOILS: A REVIEW OF SOVIET INVESTIGATIONS.

Kovalenko, I.U.A., Flanders, S.N., May 1991, 12p., ADA-238 780, Refs. p.9-12. 49-291

THERMAL CONDUCTIVITY, POROUS MATERIALS, ANALYSIS (MATHEMATICS), SOILS, BIBLIOGRAPHIES

This review concentrates on works published over the past 10-15 years, but includes important earlier publications. The authors do not claim bibliographic completeness but only aim to embrace different trends of investigations carried out in the U.S.S.R. in the field of thermal conductivity and generalized conductivity of dispersed materials and porous media, the latter two being considered mechanical mixtures without phase changes or chemical reactions among the components.

SR 91-07 DEVELOPMENT OF A FIELD SCREENING METHOD FOR RDX SOIL.

Walsh, M.E., Jenkins, T.F., June 1991, 21p., ADA-239 106, 20 refs.

46-43

CHEMICAL ANALYSIS, CHEMICAL PROPERTIES, SOIL POLLUTION, SAMPLING, SOIL CHEMISTRY, EXPLOSIVES, LABORATORY TECHNIQUES, SOIL ANALYSIS
CRREL has developed laboratory procedures to detect and quantify nitroaromatic and nitramine explosives in environmental samples. As with all methods used to detect contaminants in the environment, most of the samples analyzed prove to be blank. A more economical approach would be to screen a large number of samples on-site and to use the results to select samples for more in-depth laboratory analysis. TNT (2,4,6-trinitrotoluene) and RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) are the two explosives most commonly found in munitions-contaminated soils. Jenkins (1990) developed a field screening method to detect TNT in soil. This report will describe a complementary procedure for detection of RDX.

SR 91-08 SIMULATION OF OIL SLICK TRANSPORT IN GREAT LAKES CONNECTING CHANNELS: USER'S MANUAL FOR THE MICROCOMPUTER-BASED INTERACTIVE PROGRAM.

Yapa, P.D., Thomas, R.J., Jr., Rutherford, R.S., Shen, H.T., July 1991, 31p., ADA-241 013, 3 refs. 46-784

LAKES, COMPUTER PROGRAMS, ICE COVER EFFECT, OIL SPILLS, COMPUTERIZED SIMULATION, RIVER FLOW, GREAT LAKES

The growing concern over the impacts of oil spills on aquatic environments has led to the development of many computer models for simulating the transport and spreading of oil slicks in surface water. Almost all of these models were developed for coastal environments. In this study, two computer models, named ROSS and LROSS, were developed for simulating oil slick transport in rivers and lakes,

respectively. This report explains how to use the microcomputer-based versions of these two models.

SR 91-09 MANAGEMENT OF VEGETATION ON AMMUNITION MAGAZINES AT AMC FACILITIES.

Palazzo, A.J., Racine, C.H., Woodson, W., Pidgeon, D.E., Cate, D.W., June 1991, 24p., ADA-241 309. 46-1049

EARTHWORK, STORAGE, MILITARY FACILITIES, VEGETATION

The purpose of this study is to report the results of a survey of Army Materiel Command (AMC) facilities to assist in developing strategies for managing vegetation on ammunition bunkers or igloos. The survey questions addressed the number of igloos managed, the climate, the soils, and the types of vegetation managed. A total of 36 facilities located in 28 states were surveyed. These facilities manage 18,624 bunkers. The vegetation dominating the bunker surfaces varies according to the climate and location of the facilities. Soil types also vary widely. All respondents said that igloos provide important wildlife habitat. Vegetation management practices varied; mowing and herbicide use are common, and annual management expenses are mostly less than \$300 per igloo.

SR 91-10 PRE-CONFERENCE ABSTRACTS.

Symposium on the Tropospheric Chemistry of the Antarctic Region, Boulder, CO, June 3-6, 1991, Hogan, A.W., ed, Bowen, S.L., ed, June 1991, 66p., ADA-236 274, Abstracts only.

45-2918

SNOW IMPURITIES, ICE COMPOSITION, ATMOSPHERIC COMPOSITION, AEROSOLS, AIR POLLUTION, OZONE, ANTARCTICA**SR 91-11 OPERATORS MANUAL FOR DETERMINING MOLE PERCENT PURITY USING IMPURE.**

Pidgeon, D.E., Black, P.B., Aug. 1991, 33p., ADA-242 592, 12 refs.

46-1865

MANUALS, COMPUTER PROGRAMS, LABORATORY TECHNIQUES, DATA PROCESSING, FREEZING POINTS, TEMPERATURE MEASUREMENT, STANDARDS

This report presents the laboratory procedures and operation of the computer program IMPURE, which allows the operator to measure the mole percent purity of Standard Analytical Reference Materials (SARMS). Melting point temperature, freezing point depression and heat of fusion are measured by differential scanning calorimetry (DSC). These data are then used in van't Hoff's equation to determine molar purity. IMPURE was written to control the operation of the DSC and the analyses of the collected data according to American Society of Testing and Materials (ASTM) standards.

SR 91-12 IONPAIR: A CHEMICAL SPECIATION PROGRAM FOR CALCAREOUS AND GYPSIFEROUS SOIL SOLUTIONS.

Marion, G.M., Sep. 1991, 12p., ADA-242 593, 16 refs.

46-1866

SOIL CHEMISTRY, CHEMICAL COMPOSITION, SOIL WATER, COMPUTER PROGRAMS

The IONPAIR program was designed to speciate the chemical composition of calcareous and gypsiferous soil solutions. The program uses the Newton-Raphson algorithm to solve by successive approximations a set of non-linear equations relating ionic concentrations and activities. This program allows the user to specify as input any two of the following three variables: pH, alkalinity and P(CO₂). This flexibility allows one to check the internal consistency of experimental measurements, equilibrium constants and model assumptions. For example, is total alkalinity equal to inorganic carbon alkalinity? IONPAIR was designed as a "stand-alone" program, which means that it is easily usable and is available in both Macintosh and MS-DOS versions.

SR 91-13 ROLE OF DONOR-ACCEPTOR INTERACTIONS IN THE SORPTION OF TNT AND OTHER NITROAROMATICS FROM SOLUTION.

Leggett, D.C., Sep. 1991, 8p., ADA-243 235, Refs. p.5-8.

46-1867

EXPLOSIVES, SOIL CHEMISTRY, SOIL POLLUTION

The evidence related to sorptive interactions of nitroaromatics is reviewed. Although evidence from a variety of organic model systems suggests that sorptive interaction of nitroaromatics with organic components will occur, the statistical evidence attributes greater importance to inorganic components over organic matter in soil sorption of TNT. It was concluded that donor-acceptor interactions are more important than purely hydrophobic effects in the sorption of nitroaromatics from solution onto soils and model sorbents. Furthermore, TNT in soil-water systems may become an ultimate recipient of charge, causing its reductive transformation and subsequent covalent bonding to soil organic matter components.

SR 91-14 ICE FORCE MEASUREMENTS ON A BRIDGE PIER IN THE ST. REGIS RIVER, NEW YORK.

Haynes, F.D., et al, Oct. 1991, 6p., ADA-249 504, 10 refs.

46-3999

RIVER ICE, MEASURING INSTRUMENTS, ICE FLOES, PIERS, DESIGN CRITERIA, ICE SOLID INTERFACE

An ice force panel was installed on the upstream nose of a pier of the new (1989) bridge over the St. Regis River at Hogsburg, NY. This panel is a simply supported beam, pinned at the bottom, and has a load cell for the reaction at the top. Ice forces measured with this panel during the Mar. 16, 1990 ice run are presented. Ice failed against the panel by impact, by crushing and possibly by splitting of the floes.

SR 91-15 USER'S MANUAL FOR ESTK1D.FOR AND ESTK2S.FOR WAVENUMBER ESTIMATION ROUTINES.

Moran, M.L., Oct. 1991, 15p., ADA-244 099, 7 refs.

46-1868

MANUALS, COMPUTER PROGRAMS

This document describes the operation and structure of the Fortran programs ESTK1D.FOR and ESTK2D.FOR. These frequency domain wavenumber estimation programs implement either the Bartlett or the high-resolution Capon (1969) maximum-likelihood beamformers. The program ESTK1D.FOR forms a beam response based on a one-dimensional observation wavenumber that is rotated through wavenumber space to determine the spatial bearing of a plane wave source. ESTK2D.FOR uses the beam response in two-dimensional wavenumber space to estimate the two-dimensional wavenumber vector of a plane wave source. The discussion presented in this paper focuses on the operational details of installing and running ESTK1D and ESTK2D.

SR 91-16 ONE-DIMENSIONAL TEMPERATURE MODEL FOR A SNOW COVER; TECHNICAL DOCUMENTATION FOR SNTHRM.89.

Jordan, R., Oct. 1991, 49p., ADA-245 493, Refs. p.46-49.

46-2565

MATHEMATICAL MODELS, SNOW COVER, MASS BALANCE, SNOW COMPACTION, COMPUTERIZED SIMULATION, FLUID FLOW, PHASE TRANSFORMATIONS, METAMORPHISM (SNOW), FROZEN GROUND MECHANICS

This report provides technical documentation for the computer code SNTHRM.89, which is a one-dimensional mass and energy balance model of snow and frozen soil. The model is structured using a simplified mixture theory and addresses coupled mass and heat flow, phase change and snow metamorphism. The underlying theory and numerical equations are presented. Included are detailed descriptions of the computation of the energy fluxes at the air/snow interface and of optional routines for estimating short- and long-wave radiation on horizontal and sloped surfaces.

SR 91-17 FIELD SCREENING METHOD FOR 2,4-DINITROTOLUENE IN SOIL.

Jenkins, T.F., Walsh, M.E., Oct. 1991, 11p., ADA-245 492, 12 refs.

46-2566

SOIL POLLUTION, EXPLOSIVES, MILITARY OPERATION
A simple field screening method was developed to detect the presence of 2,4-dinitrotoluene (2,4-DNT) in soil. The method involves extraction of 2,4-DNT from the soil with acetone, generation of a bluish-purple Janowsky complex by addition of potassium hydroxide and sodium sulfite, and estimation of concentration by measuring the absorbance at 570 nm with a battery-operated spectrophotometer. While the extent of color development is also somewhat dependent on the moisture content of the soil, analysts can visually detect concentrations of 2 micrograms per gram or greater in the soil. The acetone extraction step was shown to extract at least 80% of the 2,4-DNT present in a series of field contaminated soils. A 30-minute reaction time is required after addition of the reagents, and the color, once formed, is stable for at least 60 minutes after filtration. The presence of TNT, tetryl, TNB and 2,6-DNT will result in a positive interference with this method. High concentrations of copper in the soil may result in negative interference by inhibiting the formation of the Janowsky complex or by complexing with it to modify its visual absorbance characteristics.

SR 91-18 IMPROVED SALTING OUT EXTRACTION-PRECIPITATION METHOD FOR THE DETERMINATION OF NITROAROMATICS AND NITRAMINES IN WATER.

Miyares, P.H., Jenkins, T.F., Oct. 1991, 39p., ADA-245 491, 40 refs.

46-2564

EXPLOSIVES, WATER POLLUTION, MILITARY OPERATION, WATER CONTENT, GROUND WATER, LABORATORY TECHNIQUES

An improved salting-out extraction-preconcentration, RP-HPLC-UV protocol for the determination of nitroaromatics and nitramines in water was developed. The method involves saturating a 760-mL water sample with NaCl and extracting with acetonitrile (ACN). Collected extracts are then preconcentrated and solvent exchanged to water via a Kuderna-Danish evaporator. Analysis involves solute focusing by introducing an 1100-mL sample onto a LC-8 (7.5-cm, 3-micron) column eluted with water, MeOH and THF (70.7:27.8:1.5[v/v/v]) at 2.0 mL/min followed by UV detection at 254 nm. A direct injection RP-HPLC-UV water method was developed concurrently, employing the same separation and detection techniques. Both methods are applicable for simultaneous determination of RDX, TNB, DNB, 2,4-DNT, 2,6-DNT, 2-Am-DNT and 4-Am-DNT, and HMX (salting-out only) with reporting limits ranging from 0.006 to 0.27 micrograms/L for the salting-out method and 0.12 to 1.07 micrograms/L for the direct injection method. The salting-out extraction procedure is suitable for determination of HMX, RDX, TNT, 2,4-DNT and 2,6-DNT at concentrations below the health advisory and water quality criteria proposed by the USEPA and Oak Ridge National Laboratory.

SR91-19 FIELD MEASUREMENTS OF HEAT LOSSES FROM THREE TYPES OF HEAT DISTRIBUTION SYSTEMS.

Phetteplace, G.E., Kryska, M.J., Carbee, D.L., Nov. 1991, 33p., ADA-247 460, 12 refs.

46-2918

THERMAL INSULATION, THERMOCOUPLES, ANALYSIS (MATHEMATICS), HEAT LOSS, TEMPERATURE MEASUREMENT, HEAT PIPES, HEATING, HEAT FLUX

The actual level of heat losses from operating heat distribution systems is not well known. The effect of the type of distribution system and the length of time in service in heat losses are also not known, and methods used to calculate heat losses have not been adequately verified. This report describes a field project at Ft. Jackson, SC, which addresses these needs. At Ft. Jackson three different types of systems have been instrumented: shallow concrete trench, steel conduit with supply and return in common conduit, and separate conduits for supply and return pipes. The heat losses from these systems are being monitored using several methods. Data have been collected from these sites for over four years, and some of the initial results are presented.

SR91-20 BUCKLING OF UNIDIRECTIONAL GRAPHITE/EPOXY COMPOSITE PLATES AT LOW TEMPERATURES.

Dutta, P.K., Hui, D., Traynham, Y.M., Nov. 1991, 11p., ADA-246 602, 18 refs.

47-692

COMPOSITE MATERIALS, LOW TEMPERATURE TESTS, COLD WEATHER PERFORMANCE, COLD WEATHER TESTS

A theoretical and experimental study of the buckling and postbuckling behavior of unidirectionally laminated graphite/epoxy plates was conducted under combined thermal cooling and compressive loading. The rectangular plates were simply supported at the loaded edges and free in the remaining edges. The plates were found to bend during cooling even without mechanical loads because of the negative thermal expansion coefficient of the material in the loading direction and in-plane end constraints at the two loaded edges. Such bending from thermal load was treated as an initial geometric imperfection, and the analysis was based on Koiter's theory of elastic stability. The experimental postbuckling curves agreed well with the theoretical values.

SR91-21 ANALYSIS OF THE STRESS WAVE IN SOLIDS (SWIS) FINITE ELEMENT CODE.

Faran, K.J.L., Nov. 1991, 32p., ADA-245 921, 6 refs.

46-2567

WAVE PROPAGATION, STRESSES, MATHEMATICAL MODELS, COMPUTER PROGRAMS

The Stress Wave in Solids (SWIS) finite element code is a versatile program in that it can solve problems in one, two or three spatial dimensions. Although the code assumes linear elasticity and isotropic materials, it can solve problems in regions containing up to 9 different material types. To demonstrate its utility, SWIS has been used to solve 3 classical wave propagation problems: one-dimensional longitudinal displacement, impulse along the length of a cantilevered beam and Lamb's problem. This report describes how to use SWIS by summarizing the contents of the input and output files. Discussions of damping factors, computation times and comparisons to other solutions are also included.

SR91-22 SIMULATION OF OIL SLICK TRANSPORT IN GREAT LAKES CONNECTING CHANNELS: USER'S MANUAL FOR THE LAKE-RIVER OIL SPILL SIMULATION MODEL.

Shen, H.T., Yapa, P.D., Petroski, M.E., Dec. 1991, 69p., ADA-247 141, 10 refs.

47-693

OIL SPILLS, ENVIRONMENTAL IMPACT, COMPUTERIZED SIMULATION, CHANNELS (WATERWAYS), GREAT

LAKES

The growing concern over the impacts of oil spills on aquatic environments has led to the development of many computer models for simulating the transport and spreading of oil slicks in surface water. Almost all of these models were developed for coastal environments. In this study, two computer models, named ROSS and LROSS, were developed for simulating oil slick transport in rivers and lakes, respectively. This report explains how to use LROSS, the Lake-River Oil Spill Simulation model.

SR91-23 HISTORICAL PERSPECTIVES IN FROST HEAVE RESEARCH: THE EARLY WORKS OF S. TABER AND G. BESKOW.

Black, P.B., ed, Hardenberg, M.J., ed, Dec. 1991, 169p., ADA-247 395, Refs. passim.

46-2917

ANALYSIS (MATHEMATICS), PERMEABILITY, CAPILLARITY, TEMPERATURE GRADIENTS, GROUND WATER, FROST HEAVE, SOIL PHYSICS, PAVEMENTS, SOIL FREEZING, HOARFROST, SOIL MECHANICS, ROADS, RAILROADS, HISTORY

This report contains a historical perspective of frost heave research conducted in North America and Europe since the early 1900s, and, in the interest of making some classic works on the mechanics of frost heave available in one document, Stephen Taber's two papers entitled *Frost Heaving* (1929) and *The Mechanics of Frost Heaving* (1930) published in the *Journal of Geology*, and J.O. Osterberg's translation of Gunnar Beskow's monograph, *Soil Freezing and Frost Heaving with Special Attention to Roads and Railroads* (1935).

SR91-24 POTENTIAL AIRFIELD SITES IN ANTARCTICA FOR WHEELED AIRCRAFT.

Swithbank, C., Dec. 1991, 68p., ADA-249 503, 16 refs.

46-5162

AERIAL SURVEYS, SITE ACCESSIBILITY, LOGISTICS, AIRPLANES, ICE RUNWAYS, SITE SURVEYS, ANTARCTICA

This is a report on a search for possible or potential airfield sites in Antarctica, using aerial photographs and satellite images supplemented by other data. A few sites are on ice-free ground but the majority are on inland blue ice fields. Earlier studies of potential airfields on antarctic glacier ice are referenced. The attraction of a well-chosen blue-ice runway is that construction and maintenance costs are almost nil. A number of sites have been found suitable for the operation of unmodified transport aircraft on wheels. An inland ice-field site on Mill Glacier is in use for wheel landings by LC-130 aircraft; another at Patriot Hills is in use for wheel landings by DC-6 aircraft. (Auth.)

SR91-25 ENVIRONMENTAL MONITORING AND PERFORMANCE EVALUATION OF ROLLER-COMPACTED CONCRETE PAVEMENT: CONLEY TERMINAL, BOSTON, MASSACHUSETTS.

Cortez, E.R., Eaton, R.A., Dec. 1991, 16p., ADA-247 319, 6 refs.

47-694

CONCRETE PAVEMENTS, FREEZE THAW CYCLES, COLD WEATHER PERFORMANCE

The Massachusetts Port Authority (MASSPORT) built 53,800 sq m (13.3 acres) of roller compacted concrete (RCC) pavement at the Paul W. Conley Terminal, Castle I. South Boston, MA, during the 1986 and 1987 construction seasons. This was the first time an RCC pavement was built in the multiple freeze-thaw environment of the northern United States. A system of sensors was installed at this project to monitor the main environmental parameters that affect pavements. This report describes the instrumentation system, presents a summary of the recorded data, and discusses cause-and-effect relationships between construction procedures and pavement performance.

SR91-26 DECONTAMINATION IN THE COLD USING DRY POWDERS; STUDIES WITH CHEMICAL AGENT SIMULANTS.

Heeremans, M.F., Parker, L.V., Dec. 1991, 18p., ADB-162 262, 19 refs.

46-2920

COLD WEATHER OPERATION, COLD WEATHER PERFORMANCE, MILITARY OPERATION

Current U.S. Army procedures for decontaminating surfaces that have been contaminated with chemical warfare agents utilize chemical neutralization techniques that involve using liquids at subfreezing temperatures and also usually involve using water rinses. Because of the obvious problems associated with using water or any liquid at subfreezing temperatures, this report examines using absorbent powders for decontamination at low temperatures. Wiping contaminated surfaces with paper towels was compared with applying a dry powder and then wiping it off. Four powders (Fuller's earth, sand, garden soil, and talc) were tested on both clean and dirty painted and unpainted surfaces at temperatures as low as -29 C. Two chemical agent simulants were used for this portion of the testing: a neat agent simulant (BIS) and a thickened agent simulant (IDEM). Generally,

these decontamination procedures became much more effective at low temperatures than they were at room temperature. A relatively quick procedure for decontaminating smaller equipment was developed using Fuller's earth.

SR91-27 USE OF SCRAP RUBBER IN ASPHALT PAVEMENT SURFACES.

Eaton, R.A., Roberts, R.J., Blackburn, R.R., Dec. 1991, 14p., ADA-249 505, 14 refs.

46-3552

TIRES, BITUMENS, RUBBER, ROAD ICING, CONCRETE PAVEMENTS, RUBBER ICE FRICTION

Scrap tire rubber was mixed into an asphalt concrete wearing course to study the effect of ice disbonding from the pavement surface under traffic. Rubber contents of 0, 3, 6, and 12% by weight were studied. Initial laboratory ice disbonding test results led to the development of a new paving material, Chunk Rubber Asphalt Concrete (CRAC), that uses larger pieces of rubber in a much denser asphalt concrete mix. Strength values doubled and ice disbonding performance was enhanced.

SR91-28 TESTING OF A DEICING FLUID FOAM FORMULATION FOR DECONTAMINATION AT LOW TEMPERATURES.

Walsh, M.E., Parker, L.V., Dec. 1991, 6p., ADB-162 209, 8 refs.

46-2922

ANTIFREEZES, ICE REMOVAL, ICE PREVENTION, AIRCRAFT ICING, LOW TEMPERATURE TESTS, COLD WEATHER PERFORMANCE, COLD WEATHER OPERATION

Several foam formulations have been tested for feasibility as hasty decontaminants, and as a possible alternative to conventional chemical decontaminants. At higher ambient temperatures, foam decontaminants offer several advantages: they adhere well to vertical surfaces and they are thicker than conventional decontaminants, and thus can offer a barrier to agent desorption. They also are less logistically demanding and less damaging to materials than DS2. This report focuses on the use of one of these foam decontaminants (Reformulated Aircraft Deicing Fluid or RADF) for use at subfreezing temperatures. Tests run at -29 C revealed that this formulation is not a suitable alternative to DS2. The primary problem was that the components used to make it were frozen at this low temperature. While the components could be previously mixed at higher temperatures, these mixtures would either freeze or separate upon cooling. The amount of antifreeze added to the formulation could be increased to prevent freezing, but this did not yield an acceptable product. DS2 appears to be a much better product to use at subfreezing temperatures.

SR91-29 SIMULATION OF OIL SLICK TRANSPORT IN GREAT LAKES CONNECTING CHANNELS: USER'S MANUAL FOR THE RIVER OIL SPILL SIMULATION MODEL (ROSS).

Shen, H.T., Yapa, P.D., Petroski, M.E., Dec. 1991, 94p., ADA-247 845, 6 refs.

46-2919

MODELS, COMPUTERIZED SIMULATION, OIL SPILLS, CHANNELS (WATERWAYS), ICE COVER EFFECT, ENVIRONMENTAL IMPACT, ICE CONDITIONS, RIVER FLOW

The growing concern over the impacts of oil spills on aquatic environments has led to the development of many computer models for simulating the transport and spreading of oil slicks in surface water. Almost all of these models were developed for coastal environments. In this study, two computer models, named ROSS and LROSS, were developed for simulating oil slick transport in rivers and lakes, respectively. This report explains how to use ROSS.

SR91-30 NOTES FOR COLD WEATHER MILITARY OPERATIONS.

Richmond, P.W., ed, Dec. 1991, 58p., ADB-162 421, 32 refs.

46-3039

MILITARY OPERATION, LOGISTICS, WATER SUPPLY, COLD WEATHER SURVIVAL, COLD WEATHER OPERATION, SNOW (CONSTRUCTION MATERIAL)

The effect of cold weather on personnel and equipment must be considered during planning and preparing for military operations. A large amount of information and a number of special techniques have been developed at CRREL for conducting operations in the cold. Much of this information has been incorporated into Army doctrine as doctrinal publications have been updated or rewritten. The purpose of this report is to provide a fairly comprehensive compilation of cold weather operational procedures and techniques and to consolidate, in one place, recent achievements that are not published in a doctrinal source. This report is divided into two parts. Part 1 contains current U.S. Army operational doctrine; excerpts of cold weather doctrine are presented for operations that are particularly sensitive to cold regions effects. Part 2 is a compilation of knowledge from other sources, particularly from research programs conducted by the CRREL, to provide further information on special techniques and methodologies for conducting military operations in the cold. The

following broad areas are discussed—planning, mobility, counter-mobility, survivability, decontamination, water supply and communications.

SR 91-31 CREEP AND YIELD MODEL OF ICE UNDER COMBINED STRESS.

Fish, A.M., Dec. 1991, 14p., ADA-249 788, 36 refs. 46-3553

ICE MODELS, ICE CREEP, COMPRESSIVE PROPERTIES, STRESS STRAIN DIAGRAMS, MATHEMATICAL MODELS, ICE DEFORMATION

Constitutive equations and strength criteria have been developed for ice in a multiaxial stress state. The equations developed describe the entire creep process, including primary, secondary, and tertiary creep, at both constant stresses and constant strain rates in terms of normalized (dimensionless) time. Secondary creep is considered an inflection point defining the time to failure. The minimum strain rate at failure is described by a modified Norton-Glen power equation, which, as well as the time to failure, includes a parabolic yield criterion. The yield criterion is selected either in the form of an extended von Mises-Drucker-Prager or an extended Mohr-Coulomb rupture model. The criteria take into account that at a certain magnitude of mean normal stresses the shear strength of ice reaches a maximum value due to local melting of ice. The model has been verified using test data on the yield of polycrystalline ice at -11.8 C and on creep of saline ice at -5 C, both under triaxial compression.

SR 92-01 JOINT UNITED STATES-CANADIAN OBSERVATION ANALYSIS FOR SMOKE IN SNOW (JUSCAN OASIS): SMOKE WEEK XI DATA REPORT.

Perron, F.E., Jr., ed, Hardenberg, M.J., ed, Jan. 1992, 106p., ADB-162 747, 2 refs. 46-3038

STATISTICAL ANALYSIS, MILITARY OPERATION, MILITARY EQUIPMENT, COLD WEATHER OPERATION, SNOWFALL, SNOW SURFACE TEMPERATURE, SNOW PHYSICS, SNOW COVER EFFECT

The Smoke Week XI field trials were conducted jointly by the United States and Canadian governments at the Defense Research Establishment Valcartier (DREV), Quebec, Canada, during Feb.-Mar. 1989. The Project Manager, Smoke/Obscurants (PM Smoke), and the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) were the U.S. sponsoring organizations, while other government agencies and contractors cooperated. The objectives of the field study were to 1) determine the effects of cold weather and falling snow on electro-optical and laser weapon systems with and without obscurants, 2) study the synergistic effects of snow and the dissemination of smoke and obscurants, 3) extend to cold and snow conditions the search, detection and acquisition study objectives of Smoke Week X conducted at Fort Huachuca, AZ, during Sep.-Oct. 1988, 4) assess under cold climatic conditions the field performance of inventory and developmental visual and infrared screening materials, and 5) acquire data on the effects of smokes and obscurants on target contrasts in snow environments. This data report presents information gathered at Smoke Week XI by CRREL personnel, including field data collected on meteorology, snow characterization and atmospheric propagation.

SR 92-02 ON THE USE OF AN ARTIFICIAL SNOW PLATFORM FOR WAM TESTS.

Albert, D.G., Jan. 1992, 11p., ADA-247 868, 8 refs. 46-2916

MILITARY OPERATION, MINES (ORDNANCE), SNOW (CONSTRUCTION MATERIAL), SNOW ACOUSTICS, WAVE PROPAGATION, SOUND WAVES

An experiment was conducted to test the effectiveness of using a small platform constructed of packed snow to simulate the effects of a snow cover on ground sensors used in vehicle detection and identification. A simple impulsive acoustic source (45-caliber pistol firing blanks) was used to simplify the interpretation of the experimental measurements. Geophones and microphones on the snow platform and on undisturbed snow nearby were used to record the signals. These measurements show no significant difference between signals recorded on the snow platform and on the surrounding undisturbed snow. Consideration of previous measurements and acoustic theory shows that the platform would have to be much larger in areal extent to affect the recorded signatures; it is the interaction of the acoustic waves with the ground surface over their entire propagation path that controls the properties of the signal at the ground sensor.

SR 92-03 TESTS IN ICE ON AN ANTARCTIC RESEARCH VESSEL MODEL.

Tatinclaux, J.C., Feb. 1992, 41p., ADA-249 789, 6 refs. 46-3554

SHIPS, ICEBREAKERS, DESIGN, MODELS, PRESSURE RIDGES, TESTS

A new antarctic research vessel to be chartered by the National Science Foundation was designed and is under construction by North American Shipbuilding, Inc., Larose, LA. A full model test program was required by NSF to verify that the proposed design would meet

the vessel operational requirements. In particular, the ship is to break 3 ft (0.9 m) of ice at 3 kn (1.5 m/s) continuously and break through pressure ridges with a 6 ft (1.8 m) sail and a 20 ft (6.1 m) keel. Ice model tests were made in CRREL's ice towing tank. The test program included resistance and propulsion tests in level ice, tests in ridges and ramming tests in ice floes of up to 6 ft (1.83 m) in thickness. The test results described in the report indicate that the proposed ship design with 8.8 MW of power available at the propeller would meet or exceed all operational requirements in ice. The power needed to operate continuously in 3 ft first year level ice at 3 kn was estimated at 6.5 MW; the vessel was found to be able to ram through a 38 ft (11 m) keel ridge; finally, when ramming in 6 ft thick level ice at an impact speed of 6 kn (3.1 m/s) at full power, the vessel was predicted to penetrate by about one-third of a ship length into the ice. (Auth.)

SR 92-04 EVALUATION OF A PNEUMATIC GUY-LINE DEICING BOOT.

Govoni, J.W., Franklin, C.H., Feb. 1992, 7p., ADA-252 013, 2 refs. 46-4053

ICING, ICE LOADS, ICE PREVENTION, ICE REMOVAL. During the two winter field seasons of 1986-88, a 3 m-long pneumatic cable deicing boot was tested and evaluated by CRREL at the summit of Mt. Washington, NH. Favorable results from this pilot study led to the development of a longer (14 m) pneumatic boot. This longer boot, which was used to entirely encase one of the guy lines supporting a 9 m-high tower, was evaluated at the summit of Mt. Washington during the 1987-88 icing season. The performance of both pneumatic cable deicing boots during a variety of icing conditions indicates that this simple, cost-effective method of ice prevention on guy wires may be suitable for practical application.

SR 92-05 0.45- TO 1.1-MICRON SPECTRA OF PRUDHOE CRUDE OIL AND OF BEACH MATERIALS IN PRINCE WILLIAM SOUND, ALASKA.

Taylor, S., Apr. 1992, 14p., ADA-251 911, 14 refs. 46-4052

SPECTRA, OIL SPILLS, ENVIRONMENTAL IMPACT, ENVIRONMENTAL TESTS, POLLUTION

The spectral response in the visible and near-infrared (wavelengths of 0.45 to 1.10 micron) of different amounts of Prudhoe crude oil on water was measured. Spectral reflectance measurements were made of selected beaches and beach materials in Prince William Sound to provide ground truth data for the MEIS II imagery collected during the Exxon Valdez spill. A spectral mixing model was used to predict how different amounts of oil would change the spectra of beach materials in Prince William Sound.

SR 92-06 SHIP ICING INSTRUMENTATION.

Walsh, M.R., Morse, J.S., Knuth, K.V., Lambert, D.J., Apr. 1992, 40p., ADA-251 346, 3 refs. 46-4051

SHIP ICING, ICE ACCRETION, SPRAY FREEZING, SEA SPRAY, DESIGN, ICE MODELS, MEASURING INSTRUMENTS

To gather empirical data on ship superstructure icing upon which to base and verify a computer model that can be used to predict icing events, the U.S. Army Cold Regions Research and Engineering Laboratory was asked by the U.S. Navy David Taylor Ship Research and Development Center to create a prototype system capable of collecting relevant spray and icing data on ship decks during cold-weather cruises. The resulting ship icing instrumentation can be divided into two parts: a video system to obtain a visual record of spray and icing, and several stand-alone instrumented units to obtain quantitative data. The units are capable of measuring liquid water content of spray fluxes in either the horizontal or vertical directions, measuring ice accretion in either direction, and monitoring several other parameters such as temperature and power level. Problems associated with salt water rendered most of the spray data collected during a cruise aboard the USCGC *Midgett* unusable. Some problems with surface roughness may have degraded the ice thickness data. Otherwise, the equipment worked quite well. Further work on using a capacitance gauge to measure salt water levels needs to be conducted before the equipment is redeployed at sea.

SR 92-07 PRECISION ANALYSIS AND RECOMMENDED TEST PROCEDURES FOR MOBILITY MEASUREMENTS MADE WITH AN INSTRUMENTED VEHICLE.

Shoop, S.A., Apr. 1992, 47p., ADA-252 014, 10 refs. 46-4050

STATISTICAL ANALYSIS, ACCURACY, MEASURING INSTRUMENTS, VEHICLES, COLD WEATHER OPERATION

This report addresses the precision of mobility measurements made using an instrumented vehicle. Systematic errors were documented and new techniques established to eliminate or minimize these errors. An increase in the precision and accuracy of mobility measurements will allow the successful pursuit of new research efforts of concern to cold regions mobility, such as the resistance measurements of trailing tires and terrain resistance on shallow snow or winter soils. Systematic errors due to calibration methods, temperature,

vehicle speed and weight distribution were observed and quantified. Based on these results, suggested techniques to eliminate or minimize these errors and improve precision are as follows. 1) The method of calibration (air, static or rolling) should be chosen based on the objective of the experiment. Calibrating the vehicle while it is rolling yields the most consistent results from test to test; however, static calibration is needed to measure the total resistance of the vehicle running gear. 2) Because of the wide range of temperatures considered in cold regions testing and the temperature sensitivity of the equipment, the vehicle and all equipment should be operating and temperatures stabilized before vehicle calibration and testing begins. If the weather changes significantly during the course of the tests, it should be noted and the vehicle should be recalibrated. 3) The vehicle must be on as level and smooth a surface as possible because the load on the wheels is extremely sensitive to weight distribution (and tilt) of the vehicle. Small variations in the weight distribution are also reflected in the contact area of the tires. 4) Mobility testing procedures should routinely include a hard surface motion resistance measurement for each set of test conditions to serve as a reference for the terrain mobility measurements and as a comparison between data sets.

SR 92-08 LASER DEPOLARIZATION FROM TARGETS IN A WINTER ENVIRONMENT.

Koh, G., Apr. 1992, 8p., ADB-164 886, 4 refs. 46-4370

LASERS, BACKSCATTERING, MINES (ORDNANCE), DETECTION, SNOW COVER EFFECT, ICE COVER EFFECT, FROST, COLD WEATHER OPERATION, MILITARY OPERATION

The use of a near-infrared laser (1.06 micron wavelength) scanner for the standoff detection of surface mines is currently under consideration by the military. The concept is to rapidly scan a potential minefield with a polarized laser beam and to map the backscatter intensity and depolarization patterns from the scanned area in order to determine the presence of mines. Experiments have been conducted to investigate the potential limitations of such a system in a winter environment. Metal plates were coated with military-specified primer and paints to simulate mine surfaces, and the polarization-dependent reflectance properties of these surfaces were measured. Changes caused by the presence of frost, snow, ice and water on the reflectance properties of the simulated mine surfaces were determined. The mechanisms involved in the depolarization of the laser beam backscattered from these surfaces are discussed.

SR 92-09 SADARM CAPTIVE FLIGHT TESTS: 35-GHZ GROUND-BASED RADAR SYSTEM MEASUREMENTS.

Nagle, J.A., Apr. 1992, 59p., ADA-252 553, 2 refs. 46-4369

COLD WEATHER OPERATION, MILITARY OPERATION, BACKSCATTERING, ANALYSIS (MATHEMATICS), RADAR ECHOES, ANTENNAS, RADAR

Search and Destroy Armaments (SADARM) winter captive flight tests were conducted in Grayling, MI, from Mar. 6-19, 1990 to assess the performance of SADARM sensors flying over appropriate target sets in a winter background environment. Several target configurations were used in a variety of winter conditions, including both moving and stationary targets as well as clean and countermeasured targets and decoys. Ground-based millimeter wave radar and infrared measurements made during the testing period provided data to increase the understanding of target-background interaction. This report contains the methods used to reduce and calibrate the ground-based 35-GHz radar data. Each scene imaged is described and a discussion is presented of the methods used to calculate the backscattered power and NRCS and to calibrate the radar.

SR 92-10 ACOUSTICALLY COUPLED GROUND MOTION UNDER CONTROLLED CONDITIONS: TRIAL STUDY.

Peck, L., Apr. 1992, 15p., ADA-252 384, 6 refs. 46-4368

FROZEN GROUND PHYSICS, SANDS, ACOUSTICS, ACOUSTIC MEASUREMENT, THERMOCOUPLES, LOW FREQUENCIES

A series of ground-motion experiments was done in the Frost Effects Research Facility at CRREL in 1985 and 1986 to determine the suitability of the FERF for studies of ground motion induced by low-frequency acoustic sources. A special method of freezing the contents of a FERF test basin by circulating frigid air was effective in freezing sand to a depth of 53 cm. The reverse means of thawing the sand, exposing it to the ambient temperature air in the FERF, did not allow for expeditious warming of the sand during winter months. Acoustically coupled ground motion was measured for sand conditions of dry, unfrozen; dry, frozen; saturated; and hard frozen. Ground-motion amplitude was 30-40% lower in saturated sand than in dry, unfrozen sand. This depth-dependent reduction is attributed to reduced air permeability in the saturated sand. The amplitude of acoustically coupled ground motion in hard frozen sand (sand frozen when wet) was 80-90% lower than in dry, unfrozen sand.

SR 92-11 EFFECTS OF THE ABRASIVENESS OF TEST AND TRAINING SITE SOILS ON PARACHUTE LIFE.

Hogan, A.W., May 1992, 27p., ADA-252 389, 6 refs.
46-4367

ELECTRON MICROSCOPY, MILITARY OPERATION, MILITARY EQUIPMENT, ABRASION, PARTICLE SIZE DISTRIBUTION, PHYSICAL PROPERTIES, DESERT SOILS, SOIL ANALYSIS, SANDS

Soil samples collected at proving grounds, test sites and paratroop training areas were examined in an attempt to estimate their potential abrasive properties when in contact with parachute support lines. Portions of support lines that had been invaded by grit during strain tests were also examined to determine the properties of the particles that degraded the lines. These preliminary analyses indicate that soil particles of a size comparable to that of the individual filaments of the parachute cord infiltrate to the interior of the cord, become embedded and damage the cord. It is necessary to determine some additional soil properties, most importantly effective hardness of the individual grains, to establish a general description of performance degradation.

SR 92-12 SOFTENING OF RIGID POLYVINYL CHLORIDE BY HIGH CONCENTRATIONS OF AQUEOUS SOLUTIONS OF METHYLENE CHLORIDE.

Parker, L.V., Ranney, T.A., Taylor, S., May 1992, 40p., ADA-255 453, 5 refs.
47-696

ENVIRONMENTAL TESTS, WATER POLLUTION, GROUND WATER, POLYMERS, PIPES (TUBES)

In this experiment, small pieces of rigid PVC pipe were exposed to high aqueous concentrations of methylene chloride corresponding to 0.2, 0.4, 0.6, 0.8 and 1.0 activity solutions. Samples were exposed to the test solutions for 4, 8, 15, 22 and 33 days. Samples exposed to the highest activity solution (1.0) softened within the first 4 days, while samples exposed to the 0.8 activity solution took 22 days to soften. Samples exposed to the lowest activity solution (0.2) showed no signs of softening, while the results for the samples exposed to the 0.4 and 0.6 activity solutions showed some slight changes, indicating some softening. These results reveal that concentrations of methylene chloride below 3340 mg/L (0.2 activity) will not cause softening or serious swelling of rigid PVC.

SR 92-13 UNCONVENTIONAL ENERGY SOURCES FOR ICE CONTROL AT LOCK AND DAM INSTALLATIONS.

Nakato, T., Ettema, R., Toda, K., June 1992, 37p., ADA-255 715, 15 refs.
47-697

GROUND WATER, LOCKS (WATERWAYS), DAMS, ICE CONTROL, ELECTRIC POWER

Operation of lock and dam installations is made troublesome and hazardous by ice growth along lock walls and by freezing of gates to ice covers. Since considerable amounts of power are required for ice control, lock operators are interested in utilizing economical power sources other than that generated by commercial utilities. This study attempted to determine the feasibility of using several unconventional power sources for ice control at navigation locks and dams. Considered were sensible heat from groundwater, solar power, wind power and portable hydroelectric sources. Only portable hydroelectric power is feasible. Groundwater is at best of marginal feasibility, and solar and wind power sources are unreliable.

SR 92-14 PASSIVE TECHNIQUES FOR MANIPULATING FIELD SOIL TEMPERATURES.

Marion, G.M., Pidgeon, D.E., June 1992, 11p., ADA-254 303, 8 refs.
46-5318

SOIL TEMPERATURE, GLOBAL CHANGE, CLIMATIC CHANGES, FROZEN GROUND TEMPERATURE

Recent concerns about global climate change have focused attention on the methodology for manipulating field soil temperatures. The objective of this study was to evaluate several simple, inexpensive, passive systems for changing soil surface temperature in the field. Four classes of treatments were evaluated, including plastic ground covers, fabric ground covers, fabric greenhouses, and open-top chambers. In general, treatments raised daytime maximums and lowered nighttime minimums. In some cases these opposite effects balanced, and there was no change in mean daily temperature. Five treatments changed mean daily temperature by at least ± 1.0 C; these included black plastic (-2.6 C), two clear plastic treatments ($+1.0$ C), Reemay greenhouses ($+1.0$ C), and Reemay ground covers ($+2.4$ C). A multiple linear regression analysis of maximum temperatures indicated that the temperature differential between treatment and control plots was most strongly controlled by solar radiation $>$ time \times wind speed. Differences among treatments were greatest on sunny days and minimal on rainy days. Both the present study and previous studies suggest that these passive systems can alter mean daily soil surface temperatures by, at most, ± 2.5 C.

SR 92-15 DIGGING FROZEN GROUND WITH A RIPPER BUCKET.

Sellmann, P.V., Brockett, B.E., June 1992, 9p., ADA-254 304, 10 refs.
46-5316

EXCAVATION, COLD WEATHER CONSTRUCTION, CONSTRUCTION EQUIPMENT, FROZEN GROUND STRENGTH

To improve the digging capability of small excavators and backhoes in hard and frozen ground, a bucket of special design was selected from among a variety of attachments. This bucket cuts and rips the frozen ground, as lip teeth and a set of staggered teeth attached to the back of the bucket move through an arc during bucket rotation. Digging observations were made using a small mini-excavator and an Army tractor (SEE) with a rear-mounted backhoe. Frozen ground was excavated at several sites under conditions impossible for a conventional bucket. A large variation in excavation rates (3 to 30 cu yd/hr [2.3 to 23 cu m/hr]) was observed, depending on material type, frost thickness, sharpness of the cutters and operator experience.

SR 92-16 IDENTIFICATION OF TNT TRANSFORMATION PRODUCTS IN SOIL.

Walsh, M.E., Jenkins, T.F., June 1992, 31p., ADA-255 308, 18 refs.
47-699

EXPLOSIVES, DEGRADATION, SOIL POLLUTION, TRANSFORMATIONS, MILITARY OPERATION, MILITARY RESEARCH

Solvent-extractable TNT transformation products have been identified in explosive-contaminated soils. Soils from U.S. Army installations were extracted with a variety of solvents (acetonitrile, methanol, acetone and methylene chloride) and the extracts were analyzed by RP-HPLC-UV or GC/MS, or both. The TNT transformation products TNB, TNBA, 2-amino-4,6-DNT and 4-amino-2,6-DNT were generally found in concert with TNT. Dinitroaniline, a reduction product of TNB, was also identified in several soils.

SR 92-17 SNOW CONDITIONS DURING MLRS-TGW BBU1 CAPTIVE FLIGHT PROGRAM, FORT DRUM, NEW YORK, JANUARY-FEBRUARY 1991.

Fisk, D.J., Lemieux, G.E., July 1992, 76p., ADB-167 012, 5 refs.
47-700

SNOW DENSITY, SNOW DEPTH, MILITARY OPERATION, SNOW COVER EFFECT, AIRBORNE RADAR, SNOW CRYSTALS, SNOW SURFACE, SNOW RADAR ROUGHNESS

A version of the proposed Multiple Launch Rocket System Terminally Guided Warhead's (MLRS-TGW) radar system was tested at Fort Drum, NY. The radar system was mounted on an airplane and, during the flight, scanned the ground for various targets. The background of the targets (soil, vegetation, water and snow) affects the ability of the radar system to differentiate between targets or even to see the targets, and snow, in some forms, is an especially troublesome background. The purpose of the flight test was to further refine the radar hardware and software to reduce the effects of a snow background, or to develop criteria for the use of the MLRS-TGW. To do this, radar performance must be related to snow conditions. Therefore, while the radar was flying, CRREL measured snow conditions: vertical profiles of depth, density, wetness, and crystal sizes and types, and surface roughness. And since snow conditions are closely related to weather conditions, and weather conditions are more commonly reported, weather conditions as measured at Fort Drum's Wheeler-Sack Airfield were reported. This may ultimately aid in developing weather-based criteria for the use of MLRS-TGW.

SR 92-18 DETERMINATION OF THE WATER CONTENT OF SNOW BY DIELECTRIC MEASUREMENTS.

Camp, P.R., LaBrecque, D.R., July 1992, 38p., ADA-256 299, 22 refs.
47-1899

SNOW WATER CONTENT, DIELECTRIC PROPERTIES, SNOW ELECTRICAL PROPERTIES

The dielectric properties of wet and dry natural snow were studied in the frequency range of 50 Hz to 100 kHz to determine whether measurements made in this frequency range might prove useful in evaluating the water content of snow. Dielectric heating at 20 kHz proved a very useful means of modifying the water content from 0 to 30% by weight. Six different natural snows were used in these experiments. Meltwater was analyzed for conductivity, pH, and impurity content. In addition to developing information on the dielectric properties of wet and dry snow, the authors measured the changes produced in dry snow by altering its density over the range of 0.11 to 0.66 g/cu cm. Details of the experimental technique and the data obtained are fully reported. Results do not lead to optimism about the usefulness of measurements in this frequency range alone for the determination of water content.

SR 92-19 LONGBOW-APACHE FIELD EXPERIMENT: DATA REPORT.

Bates, R.E., Fiori, J.E., Fisk, D.J., Harrington, B.G., July 1992, 53p., ADB-167 107, 5 refs.
47-701

ICING, MILITARY OPERATION, SNOW DENSITY, SNOW DEPTH, SNOW COVER EFFECT, SNOW CRYSTALS, SNOW SURFACE, THERMOCOUPLES

U.S. Army Aviation Systems Command (AVSCOM) winter field experiments were conducted from Feb. 24 through Mar. 16, 1991 at Fort Drum, NY. The Longbow millimeter wave (mmw) seeker was flown over appropriate target arrays while ground-based sensors were used to evaluate the sensor system under development and to evaluate target-background interaction. In addition, the winter background environmental conditions encountered during the 20-day test period were documented. There was an extreme icing event during the test period, but the Longbow systems were grounded while it was going on owing to its severity.

SR 92-20 SALMON RIVER EXPERIMENTAL ICE BOOM: 1989-90 AND 1990-91 WINTER SEA- SONS.

White, K.D., July 1992, 17p., ADA-255 230, 34 refs.
47-702

FRAZIL ICE, ICE BOOMS, ICE CONTROL, ICE JAMS, DESIGN, UNITED STATES—IDAHO—SALMON RIVER

The city of Salmon, ID, is affected by flooding resulting from a frazil ice jam, known as the Deadwater jam, which forms annually on the Salmon River. Because the river has considerable environmental, economic, aesthetic, and recreational value, an innovative approach to frazil ice control is needed. The steep slope and turbulence of the river also add to ice control design constraints. Past investigations have examined a number of different methods to control the ice. This report documents two years of testing of an experimental ice formation boom located upstream from the city of Salmon. The observations show that boom configuration is an important factor in ice capture efficiency, and that conventional boom siting criteria may be modified under certain conditions.

SR 92-21 SUPERCRITICAL FLUID CHROMATOGRAPHY FOR THE ANALYSIS OF NITROAROMATICS, NITRAMINES AND NITRATE ESTERS.

Miyares, P.H., Aug. 1992, 14p., ADA-256 297, 42 refs.
47-708

ENVIRONMENTAL IMPACT, POLLUTION, EXPLOSIVES, MILITARY OPERATION

A supercritical fluid chromatographic (SFC) system equipped with a capillary column and a thermionic ionization detector (TID) was evaluated as a potential analytical tool for the simultaneous determination of nitroaromatics, nitramines and nitrate esters. Examination of several stationary phases and modified fluids was carried out while determining optimal conditions for a suitable separation. The results indicate that a cyanopropyl stationary phase is best suited for these analytes, but the available percentages of cyanopropyl in the phase (i.e. 25% and 50%) do not give total resolution. The performance and usability of the TID was evaluated. Detection limits are estimated to be several times greater than those for standard HPLC and GC methods. Also, the usability and performance of the SFC were compared with HPLC and GC. SFC-TID can be used for the simultaneous determination of nitroaromatic, nitramines and nitrate esters, but current column and detection capability limitations greatly reduce its potential.

SR 92-22 GLACIER, RIVER AND SEA ICE BLISTER OBSERVATIONS.

Kovacs, A., Aug. 1992, 14p., ADA-256 301, 35 refs.
47-785

SEA ICE, RIVER ICE, GLACIER ICE, FROST MOUNDS, WATER SUPPLY, GREENLAND—JAKOBHAVNS ISBRAE, ANTARCTICA—KOETTLITZ GLACIER, CANADA—YUKON TERRITORY—FIRTH RIVER, UNITED STATES—ALASKA—KATAKLURUK RIVER, UNITED STATES—ALASKA—UMIAT, UNITED STATES—ALASKA—KUPARUK RIVER

Ice blister observations made by the author in Greenland, Alaska and Antarctica are discussed. Ice blisters up to 3 m high and tens of meters long were observed on rivers and glaciers as well as on a sub-surface glacial pool. Ice blisters observed by other investigators are also discussed, as is ice blister morphology (solid, hollow or water-filled), the processes associated with their formation and their potential as a resource for potable water. (Auth.)

SR 92-23 POTENTIAL CAUSE FOR LOW LEAD AND CHROMIUM RECOVERIES DURING ACID EXTRACTIONS.

Hewitt, A.D., Cragin, J.H., Oct. 1992, 6p., ADA-259 228, 8 refs.
47-1898

SOIL POLLUTION, WASTES

When high concentrations (>100 mg/L) of Pb and Cr (IV) are present

together in solution, PbCrO₄ precipitates, resulting in losses of these two metals. Moderate acidification with 1-2% HNO₃ does not prevent precipitation loss. Caution is necessary when preparing standard solutions or handling acidic extracts of environmental samples containing high levels of Pb and Cr, since undetected formation of metal chromates will result in low recoveries of these metals.

SR 92-24

GEOLOGY AND GEOHYDROLOGY AT CRREL, HANOVER, NEW HAMPSHIRE: RELATIONSHIP TO SUBSURFACE CONTAMINATION.

Shoop, S.A., Gatto, L.W., Nov. 1992, 83p., ADA-260 140, 55 refs.

47-2568

GEOLOGY, GROUND WATER, HYDROLOGY, WELLS, ENVIRONMENTAL IMPACT, WATER POLLUTION, SOIL POLLUTION

Trichloroethylene (TCE) was discovered in three of the industrial wells at CRREL, as well as in two domestic wells in bedrock across the river. This report describes the geohydrology of the CRREL vicinity and the subsurface behavior of TCE as part of the preliminary assessment of the CRREL site. There are three hydrologic units near CRREL—a high permeability esker deposit, lower permeability lake sediments and fractured bedrock. The esker is a high-yield sand aquifer paralleling the river that provides industrial water to CRREL from four wells. The pumping of these wells may induce groundwater recharge from the river. The lake deposits consist of fine-grained silt and sand with some clay, and these cover the esker deposit. These sediments lie above the fractured, folded and metamorphosed volcanics (schist and phyllite) of the Orfordville formation. The free surface water table shows very little hydraulic gradient and appears to be continuous through these units, indicating that they are hydraulically connected. TCE can migrate in the vapor phase, as a soluble component moving along with the groundwater, and as a separate or free phase. Small spills of TCE in the fine-grained soils at CRREL may not have exceeded the retention capacity of the soils and may remain within the soil pores, with a soluble component reaching the groundwater through infiltration. Larger spills may have passed through the saturated soil zone seeking bedrock lows, continuing their downward movement along bedrock fractures. Since the CRREL wells may induce recharge from the river, the possibility of the contamination coming from that direction should not be overlooked.

SR 92-25

COMPARISON OF CARTRIDGE AND MEMBRANE SOLID-PHASE EXTRACTION WITH SALT-OUT SOLVENT EXTRACTION FOR PRECONCENTRATION OF NITROAROMATIC AND NITRAMINE EXPLOSIVES FROM WATER.

Jenkins, T.F., Miyares, P.H., Myers, K.F., McCormick, E.F., Strong, A.B., Dec. 1992, 31p., ADA-260 177, 32 refs.

47-2232

EXPLOSIVES, SOIL POLLUTION, CHEMICAL ANALYSIS, GROUND WATER

Salt-out solvent extraction (SOE) was compared with cartridge and membrane solid phase extraction (SPE) for preconcentration of nitroaromatic and nitramine explosives from water, prior to reversed-phase high performance liquid chromatographic analysis (RP-HPLC). The procedures were compared initially using reagent grade water fortified with TNT, RDX, HMX and nine other analytes at concentrations below what could be determined without preconcentration, and the results were used to estimate analyte recovery and the low concentration detection capability, as characterized by the Certified Reporting Limit (CRL). CRLs for the three procedures were comparable, with values generally in the range of 0.05 to 0.30 microgram/L. Percentage recoveries for the three procedures were generally greater than 90%, except for those of HMX and RDX obtained by the membrane-SPE procedure. A second comparison among the three procedures was obtained on 58 groundwater samples from the Rocky site at the Naval Surface Warfare Center, Crane, IN. Results from a direct analysis procedure were compared to those from the three preconcentration techniques to estimate percent recovery of HMX, RDX and TNT for real samples. Recoveries were greater than 80% except for HMX and RDX by the membrane-SPE method. Both SPE procedures exhibited background interferences, which the authors attribute to matrix interaction with the SPE polymers. Usability of the three procedures in a production-oriented laboratory was evaluated with emphasis on solvent consumption, waste production and sample processing time. The cartridge-SPE was judged to be the least rugged of the three procedures.

SR 92-26

UNSURFACED ROAD MAINTENANCE MANAGEMENT.

Eaton, R.A., Beauchamp, R.E., Dec. 1992, Var. p., ADA-262 015, 11 refs.

47-2756

ROAD MAINTENANCE, MILITARY FACILITIES

This draft manual describes an unsurfaced road maintenance management system for use on military installations. This system is available in either a manual or computerized model (Micro PAVER). The maintenance standards prescribed should protect Government property with an economical and effective expenditure

of maintenance funds commensurate with the functional requirements and the planned future use of the facilities. Because of limited maintenance funds, timely and rational determination of maintenance and repair (M&R) needs and priorities are very important factors. These factors can be determined by using the system as described in this draft manual. The use of the unsurfaced road maintenance management system by personnel who have the responsibility for unsurfaced road maintenance should assure uniform, economical, and satisfactory unsurfaced area maintenance and repair.

SR 92-27

PROCEEDINGS.

International Conference on Snow Engineering, 2nd, Santa Barbara, CA, June 21-26, 1992, Tobiasson, W., ed, Wright, E.A., ed, Dec. 1992, 485p., ADA-263 267, Refs. passim. For individual papers see 47-3183 through 47-3229.

47-3182

SNOWDRIFTS, SNOW COVER STABILITY, DESIGN CRITERIA, SNOW LOADS, ROOFS, SNOW REMOVAL, COLD WEATHER CONSTRUCTION, SNOW DEPTH, SNOW SURVEYS, BUILDING CODES

SR 92-28

BEARING CAPACITY TESTS ON ICE REINFORCED WITH GEOGRID.

Haynes, F.D., Collins, C.M., Olson, W.W., Dec. 1992, 12p., ADA-262 715, 22 refs.

47-2925

BEARING TESTS, ICE COVER STRENGTH, ICE CROSSINGS, GEOTEXTILES

Laboratory tests were conducted on floating freshwater ice sheets, reinforced with a high-strength polymeric mesh (Geogrid). The mesh was frozen into the ice sheets. Bearing capacity tests were conducted on each ice sheet, whose thickness varied from 3 to 13 cm, while the dynamic loads varied from 1.3 to 23 kN. Comparisons to tests on ice without reinforcement were made; Geogrid reinforcement increased the bearing capacity of thin (49 mm) ice up to 38% and of thicker ice (96 mm) about 10-15%. Failure of the ice with Geogrid reinforcement was local, whereas failure of the ice without Geogrid was over a large area. Displacement of the ice is compared to theory for plates on an elastic foundation. Field tests were conducted at Fort Wainwright, AK. A small unit support vehicle (Hagglunds BV 206) was used for loading a reinforced ice sheet that was 53 cm thick. The Geogrid, even though it was frozen into the top 7.6 cm of the ice sheet, reduced the deflection of the ice sheet.

SR 93-01

FIELD SURVEY OF POTENTIAL AIRSTRIP

LOCATIONS: MT. HOWE, ANTARCTICA, 1991.

DenHartog, S.L., Feb. 1993, 6p., ADA-263 199, 1 ref.

47-3338

ICE RUNWAYS, AIRCRAFT LANDING AREAS, ICE CONSTRUCTION MATERIAL, ANTARCTICA—HOWE, MOUNT

The blue ice area just west of the Mt. Howe ridge was surveyed with the intent of establishing a runway for large, wheeled cargo aircraft. Site limitations and wind observations precluded selection of an airstrip location. Installation of an automatic weather station to monitor winds at the site will allow determination of site suitability. (Auth.)

SR 93-02

SNOW CONDITIONS DURING MLRS-TGW BBS EUROPEAN CAPTIVE FLIGHT PROGRAM, HESSEN, GERMANY, FEBRUARY 1992.

Fisk, D.J., Feb. 1993, 37p., ADB-173 343, 8 refs.

47-3796

MILITARY EQUIPMENT, MILITARY OPERATION, RADAR, AIRBORNE RADAR, SNOW COVER EFFECT, COMPUTER PROGRAMS, COMPUTERS, DATA PROCESSING, COLD WEATHER PERFORMANCE

A version of the proposed Multiple Launch Rocket System-Terminal Guided Warhead's (MLRS-TGW) radar system was tested in central Germany. The radar system (Brassboard Seeker) was mounted on an airplane and, during flight, scanned the ground for various targets. The background of the targets (soil, vegetation, water and snow) affects the ability of the radar system to differentiate between targets or even to see the targets, and snow, in some forms, is an especially troublesome background. The purpose of the flight test was to further refine the radar hardware and software to reduce the effects of a snow background, or to develop criteria for the use of the MLRS-TGW. To do this, radar performance must be correlated with snow conditions. Therefore, while the radar was flying, CRREL measured snow conditions: vertical profiles of depth, density, wetness, and crystal sizes and types, and surface roughness. Those data are reported here.

SR 93-03

SITE CHARACTERIZATION MEASUREMENTS OF BACKGROUND AND TARGETS IN SUPPORT OF SMART WEAPONS TESTING.

Hayward, M., Long, K., Berger, R., Mar. 1993, 96p., ADB-174 199, 1 ref.

47-4664

DATA PROCESSING, MEASUREMENT, MILITARY OPER-

ATION, MILITARY RESEARCH, INFRARED MAPPING

In the spring of 1989 the U.S. Advanced Research Projects Agency sponsored a data collection exercise to obtain target and background signatures at infrared and millimeter wavelengths. To support the airborne data collection effort, extensive ground-based measurements were made to characterize the targets, the background and meteorological conditions during the airborne measurements. These ground-based measurements were designed to record characteristics of the background scenes that have the greatest influence on the infrared and millimeter wave sensors. Other scene characteristics were also measured so that the scenes may be compared and put into the context of the local climatic conditions. The measurements and measurement techniques are described and representative data from each measurement are presented.

SR 93-04

ICING OF TURBINE INTAKE LOUVERS.

Walsh, M.R., Garfield, D.E., Morse, J.S., Knuth, K.V., Mulherin, N.D., Lemieux, G.E., Apr. 1993, 37p., ADA-265 714.

47-4095

SHIP ICING, ICE ACCRETION, ICING RATE, ICE SOLID INTERFACE, DESIGN, ICE DENSITY, SEA SPRAY, ICE SALINITY

Superstructure icing can have debilitating effects on the operation of any ship. When designing ships that will operate in environments where icing may occur, careful consideration must be given to minimizing the accumulation and effect of shipboard icing. Such consideration was given to the Navy DDG-51 class destroyer when new turbine intake louvers were proposed. To ensure that sufficient air would be available to the vessel's gas turbines and ventilation system during an icing event, the U.S. Navy tasked the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) to conduct a series of comparative icing tests between standard intake louvers and a new louver design. Using a test matrix and design parameters supplied by a Navy contractor, CRREL designed a test apparatus and instrumentation suite to carry out the tests. Testing conducted with reconstituted seawater at the CRREL facility demonstrated that, under various icing conditions, the rate of ice accumulation of the two louver designs was very similar. However, the increased number of louver vanes of the proposed design led to more rapid restriction of ice accumulation on the vanes.

SR 93-05

FEASIBILITY STUDY OF PREPARING PERFORMANCE EVALUATION SOILS FOR ANALYZING VOLATILE ORGANIC COMPOUNDS.

Hewitt, A.D., May 1993, 9p., ADA-266 410, 19 refs.

47-4663

LABORATORY TECHNIQUES, SOIL POLLUTION, VAPOR DIFFUSION

Vapor fortification, an alternative method for spiking soils with volatile organic compounds for quality assurance/quality control, was improved by minimizing the effects of numerous variables. The procedure developed resulted in average analyte concentrations for triplicate test samples that were not significantly different among three separate fortification treatments, and had relative standard deviations within each treatment of less than 9% for three of the four analytes tested. The advantages of using vapor fortification instead of the conventional liquid injection methods are discussed.

SR 93-06

BIBLIOGRAPHY ON SNOW AND ICE FRICTION.

Colbeck, S.C., May 1993, 17p., ADA-266 868, Refs. p.1-17.

47-4869

BIBLIOGRAPHIES, ICE FRICTION, SNOW MECHANICS, SNOW ICE INTERFACE, RUBBER SNOW FRICTION, WOOD SNOW FRICTION, SKIS

This is a bibliography compiled for use by anyone interested in friction on snow or ice surfaces. The items are separated into snow and ice categories because the physical processes and the problems on these two surfaces are somewhat different. There is some repetition between the lists because some references are appropriate for both subjects. The references were selected because they were of direct interest to the subject of friction and not just because knowledge of friction was important in the study. That is, the references selected provide information about friction and do not just use such information.

SR 93-07

COMPARISON OF AIRBORNE ELECTROMAGNETIC INDUCTION AND SUBSURFACE RADAR SOUNDING OF FRESHWATER BATHYMETRY.

Kovacs, A., Holladay, J.S., May 1993, 9p., ADA-268 703, 14 refs.

49-293

ELECTROMAGNETIC PROSPECTING, SOUNDING, LAKE ICE, ICE COVER THICKNESS

A helicopter-borne electromagnetic induction (EMI) sounding system, operating at frequencies of 0.9, 4.6 and 33 kHz, was used in an attempt to profile freshwater bathymetry under an ice-covered lake. The EMI sounding results were compared with bathymetric measurements made by tape sounding and impulse radar sounding (120 and 280 MHz). As expected, the radar-measured depths were in

excellent agreement with the tape measurements. The EMI bathymetry determinations were not representative of the lake bed topography. It is speculated that the EMI system was affected by an electromagnetic response from other than the freshwater/sediment interface.

SR 93-08

EFFECT OF CONCENTRATION ON SORPTION OF DISSOLVED ORGANICS BY WELL CASINGS.

Parker, L.V., Ranney, T.A., May 1993, 17p., ADA-266 858, 17 refs.

GROUND WATER, WELL CASINGS, SOIL POLLUTION, WATER POLLUTION, ENVIRONMENTAL TESTS, ENVIRONMENTAL IMPACT

This report examines sorption of low ppb levels of organic solutions by polytetrafluorethylene (PTFE), rigid polyvinyl chloride (PVC) and stainless steel 304 and 316 well casings. Nineteen organics that were either on the EPA priority pollutant list or of concern to the U.S. Army were selected, including several munitions and chlorinated solvents. These compounds were selected to give a range in physical properties such as solubility in water, octanol-water partition coefficient and molecular structure. When these results were compared with the results from a similar study conducted at ppm levels, the rate and extent of sorption by PTFE and PVC was the same for almost all analytes. There were no losses of any compounds associated with stainless steel. At these low levels (ppm and ppb) the rate of diffusion within the polymer (PVC and PTFE) is independent of concentration. Only with PTFE are the rates rapid enough to be of concern when monitoring for some compounds in groundwater. Tetrachloroethylene was the compound sorbed by PTFE the most rapidly. The study showed that PVC well casings are suitable for monitoring low levels (ppm and ppb) of organics.

SR 93-09

DYEING OF SNOW SURFACES TO OBSERVE STRUCTURE.

Kovacs, A., June 1993, 9p., ADA-268 460, 7 refs.

COLORED SNOW, SNOW COVER STRUCTURE, SNOW MORPHOLOGY, SNOW SURFACE

A surface coloring method is described for highlighting the natural stratigraphy and load-induced structure in snow at low ambient temperatures in confined areas. The method includes planing the wall of a snow pit and then dyeing the surface using an alcohol dye applied by an electric sprayer. Surface heating and backlighting are also discussed as methods for revealing hidden detail, especially when photographic evidence of the snow structure is important.

SR 93-10

PROMOTING LATE-FALL ESTABLISHMENT OF TALL FESCUE WITH SOIL COVERS.

Palazzo, A.J., Bailey, R.N., Diener, C.J., June 1993, 8p., ADA-268 699, 14 refs.

REVEGETATION, GRASSES

Turfgrass seedlings frequently have been sown in the late fall, which usually results in a poor vegetative stand the following spring. This study evaluated the effects of a spun-bonded polypropylene soil cover placed over a late-fall seeding on subsequent seedling growth and overwintering. Clemfine, Mustang, Rebel and Rebel II cultivars of tall fescue (*Festuca arundinacea* Schreb.) were sown on a silt loam soil in late fall (Oct. 17, 1989 and Oct. 19, 1990) and allowed to grow with and without a soil cover until June. From mid-Apr. through May the temperature under the soil cover was more than 2°C higher than in the uncovered soil. Over the winter, leaf and root weights showed no detrimental effects from being under the cover. All cultivars had similar amounts of growth under the cover and produced 2 to 11 times greater leaf yields and 38 to 270% better stand establishment than those sown on the exposed soil. However, plant winter injury was observed under the soil cover in small soil depressions, which accumulated water originating from thawing. The covers also promoted weed growth, which was negatively correlated to the yields of the sown grass. Plant carbohydrate levels were lower beneath the soil cover than in the control, but the reduction was not sufficient to reduce spring growth. The soil cover was found to be beneficial to the establishment of late seedings of tall fescue in cold areas.

SR 93-11

EXPERIMENTAL ASSESSMENT OF ANALYTICAL HOLDING TIMES FOR NITROAROMATIC AND NITRAMINE EXPLOSIVES IN SOIL.

Grant, C.L., Jenkins, T.F., Golden, S.M., June 1993, 18p., ADA-269 721, 19 refs.

EXPLOSIVES, MILITARY RESEARCH, SOIL POLLUTION, FROZEN GROUND

A study was conducted to experimentally evaluate the maximum acceptable preextraction analytical holding times (MHTs) for three nitroaromatic compounds and two nitramines in soil. Three spiked soils and a field-contaminated soil were utilized in the study. Analytes investigated were HMX, RDX, TNB, TNT and 2,4-DNT, all at the low microg/g level. Subsamples of each soil were extracted with acetonitrile in an ultrasonic bath after being held for periods of 0, 3,

7, 14, 28 and 56 days at either room temperature (22°C), under refrigeration (2°C) or frozen (-15°C). Extracts were analyzed by RP-HPLC. The two nitramines, HMX and RDX, were stable over the entire period for all soils under all storage temperatures. For the three nitroaromatics (TNB, TNT and 2,4-DNT) the results were very different, in that all three analytes rapidly degraded in spiked soils at room temperature, more slowly degraded under refrigerator temperature and remained quite stable when frozen. Of the three, TNB degraded most rapidly, followed by TNT and 2,4-DNT. The degradation at room temperature and in the refrigerator was much faster for one soil than for the others. Even when frozen there was a small loss of 2,4-DNT in the soil showing the most rapid degradation. For the field-contaminated soil, the nitroaromatics were much more stable, even at room temperature, although some degradation occurred. Because of the large stability difference between fortified and field-contaminated soils, the efficacy of using fortified soils to estimate MHTs is discussed. The recommended MHT for soils containing only nitramines is eight weeks under refrigeration. When nitroaromatics are present, refrigeration is inadequate and soils should be frozen to preserve analyte integrity. When frozen, an MHT of eight weeks is recommended.

SR 93-12

ON WINTER WARFARE.

Swinzow, G.K., June 1993, 68p., ADA-270 031, Refs. p.66-68.

48-1003

MILITARY OPERATION, COLD WEATHER OPERATION, HISTORY

The report is a review of the history and art of winter warfare. It attempts to publicize a neglected subject by making historical facts concerning it available in a single volume. Part I covers winter warfare through the ages, beginning with Genghis Khan and ending with World War II, a period of 700-odd years. Part II covers the art of winter warfare as practiced during recent decades. Part III consists of illustrations which present additional points and expand upon the other two parts. It is noted that throughout history the lessons learned on the subject have continually been ignored and forgotten. All other conditions being equal, the most important factors determining an army's winter warfare capability are the individual soldier's willingness to accept hardship, the quality of his training, including survival skills, and his morale. Snow, ice and low temperatures can become a strategic advantage to the well-trained, highly motivated combatant.

SR 93-13

SELECTION OF COOL-SEASON GRASSES FOR REVEGETATING WELL-DRAINED FILL MATERIALS.

Palazzo, A.J., June 1993, 5p., ADA-268 459, 17 refs.

49-294

GRASSES, EARTH FILLS, REVEGETATION

The objective of this study was to evaluate the performance and persistence of 11 cool-season grasses growing in well-drained fill materials. Grasses were evaluated over a four-year period and grown on fill material containing 11% gravel, 61% sand, 27% silt and 1% clay at the Franklin Falls Dam in Franklin, NH. During the second season, half of each plot was refertilized. Visual observations of the sown grasses suggested that moisture stress was an important factor limiting growth. During the last two years of study, the most persistent species were Jamestown chewings fescue (*Festuca rubra* L. ssp. *commutata* Gaud.) and Canada bluegrass (*Poa compressa* L.). Refertilization helped to promote growth and increase persistence of all the sown species except for Jamestown chewings fescue. Three improved varieties of the grasses were not consistently more persistent than their common counterparts. This study demonstrates that there are major differences among cool-season grasses in their ability to tolerate well-drained, low-maintenance sites. When refertilized, varieties of tall fescue (*Festuca arundinacea* Schreb.) and Kentucky bluegrass (*Poa pratensis* L.) were more persistent, and a perennial ryegrass (*Lolium perenne* L.) provided rapid emergence.

SR 93-14

DEVELOPMENT OF AN IMPROVED CONFIRMATION SEPARATION SUITABLE FOR USE WITH SW846 METHOD 8330.

Jenkins, T.F., Golden, S.M., June 1993, 9p., ADA-269 720, 7 refs.

48-723

WATER POLLUTION, EXPLOSIVES, SOIL POLLUTION, SOIL CHEMISTRY, CHEMICAL ANALYSIS, MILITARY RESEARCH

An improved RP-HPLC confirmation separation was developed that is suitable for use with EPA SW 846 Method 8330. This separation provides adequate resolution of the analytes most commonly found in explosives-contaminated waters and soils. The separation is achieved on an LC-CN (cyanopropyl) column eluted with an eluent composed of water (65%), methanol (12%) and acetonitrile (23%) at 1.2 mL/min. Analysis of field-contaminated soil and groundwater samples indicate that this confirmation separation is an improvement over the confirmation separation currently recommended in SW846 Method 8330.

SR 93-15

MODELING ICE PASSAGE THROUGH AN AUXILIARY LOCK CHAMBER WITH A SUBMERGIBLE LIFT GATE.

Zufelt, J.E., Rand, J., Gooch, G., June 1993, 13p., ADA-268 702, 5 refs.

49-289

RIVER ICE, ICE MODELS, MARINE TRANSPORTATION, LOCKS (WATERWAYS), ICE MECHANICS, MODELS, ICE NAVIGATION, UNITED STATES—MISSISSIPPI RIVER
River ice from the Des Moines and Fox Rivers combines with that of the Mississippi during spring breakup, resulting in massive ice accumulations upstream of Lock and Dam 20 on the Mississippi River. The accumulations in the upper lock approach area cause considerable delays to navigation, as ice must be passed through the lock chamber to clear the approach. A physical model study was conducted to determine the effects of using the existing auxiliary lock chamber to pass ice. The auxiliary lock chamber was fitted with a submergible lift gate at its upstream end that could be lowered to pass ice and clear the upper lock approach area. Model tests were conducted with real and plastic ice material to simulate the brash ice conditions encountered during low-flow prototype winter conditions. The submergible lift gate worked well in clearing ice accumulations from the upper lock approach. It was necessary to disturb the accumulation and keep it from refreezing by simulating towboat movement or high volume point source air bubblers to thoroughly clear the approach area.

SR 93-16

BEAUFORT SEA COASTAL FISH STUDIES: OVERVIEW AND BIBLIOGRAPHY.

Harris, R.K., June 1993, 25p., ADA-268 701, Refs. p.4-25.

48-40

ANIMALS, MARINE BIOLOGY, BIBLIOGRAPHIES, BEAUFORT SEA

Arctic fish are an important subsistence resource for the people living on the North Slope of Alaska. Many research efforts have investigated and monitored fish populations for the purpose of minimizing the impact of oil development on the fish. Many of these studies are in reports to various government agencies and may not be easily accessible. This report provides a general overview of the fish research done and lessons learned in the Alaskan Arctic for use by agencies involved in permitting future development. It allows access to the literature by listing other arctic fish bibliographies and providing species-specific bibliographies. The work focused on eight fish species identified as having ecological, subsistence or recreational value: arctic char (*Salvelinus alpinus*), arctic cisco (*Coregonus autumnalis*), arctic (polar) cod (*Boreogadus saida*), broad whitefish (*C. nasus*), burbot (*Lota lota*), grayling (*Thymallus* sp.), least cisco (*C. sardinella*) and saffron cod (*Eleginus gracilis*).

SR 93-17

PROCEEDINGS.

International Conference on Winter Vehicle Mobility, 1st, Santa Barbara, CA, June 1991, Blaisdell, G.L., ed, July 1993, 214p., ADA-271 546, Refs. passim. For individual papers see 48-1161 through 48-1181.

48-1160 ALL TERRAIN VEHICLES, MOTOR VEHICLES, SNOW VEHICLES, TRACKED VEHICLES, COLD WEATHER OPERATION, COLD WEATHER PERFORMANCE, MILITARY TRANSPORTATION

The First International Conference on Winter Vehicle Mobility was the first international meeting entirely devoted to the subject of vehicle travel in cold regions. The technical sessions focused on prediction and testing methods, general vehicle mobility, mobility enhancement, cold regions materials properties, and novel designs for winter mobility. This report includes 21 papers presented at the conference.

SR 93-17

INVESTIGATION OF FORCES INCURRED DURING SNOW PLOWING.

Steiger, W., Hansen, A., Pell, K., July 1993, International Conference on Winter Vehicle Mobility, 1st, Santa Barbara, CA, June 1991. Proceedings. Edited by G.L. Blaisdell, p.103-112, ADA-271 546.

48-1170

SNOW REMOVAL, DESIGN, DESIGN CRITERIA, EQUIPMENT

SR 93-18

DISTRIBUTION OF WHITE PHOSPHORUS RESIDUES FROM THE DETONATION OF 81-MM MORTAR WP SMOKE ROUNDS AT AN UPLAND SITE.

Walsh, M.E., Collins, C.M., Aug. 1993, 8p., ADB-176 691, 14 refs.

48-1002

MILITARY OPERATION, MILITARY RESEARCH, EXPLOSION EFFECTS, SOIL POLLUTION

Tests were conducted to determine the spatial distribution and short-term persistence of white phosphorus (WP) residue following the detonation of 81-mm mortar WP smoke rounds. At the point of

impact, WP was driven into the soil matrix to a depth of 20 cm, resulting in a WP soil concentration on the order of 100 microg/g. Away from the point of detonation, the amount of WP residue deposited from the exploding shell decreased exponentially, with most of the WP found within a 10 m radius. The WP was deposited in the form of particles approximately 1 mm in length. Samples taken from craters four months after impact had WP concentrations around 20 microg/g, indicating that WP does not rapidly oxidize in a soil matrix.

SR93-19 DELIVERY OF FUEL AND CONSTRUCTION MATERIALS TO SOUTH POLE STATION.

DenHartog, S.L., Blaisdell, G.L., July 1993, 21p., ADA-270 431, 17 refs.

48-1001

LOGISTICS, ICE RUNWAYS, RUNWAYS, TRAVERSES, COST ANALYSIS, COLD WEATHER CONSTRUCTION, ANTARCTICA—AMUNDSEN-SCOTT STATION

Plans are underway to rebuild South Pole Station, ideally with minimal impact on the current science and operational program. The new station will require the delivery of massive amounts of construction materials to this remote site. The existing means of delivery to the South Pole include the use of specialized LC-130 Hercules aircraft that can operate on wheels or skis, and some materials are also air-dropped from C-141 aircraft. Neither of these delivery systems is expected to be capable, within a reasonable time period, of supporting both current operations and the transport needs for construction of a new station. Several options for moving construction materials and fuel to South Pole Station are analyzed. All of the options assume that goods will be transported to the antarctic continent by ship. The options include a) construction of a snow runway at the South Pole capable of supporting wheeled aircraft, b) development of an inland blue-ice runway capable of supporting heavy wheeled aircraft, located as close as possible to the South Pole, with over-snow vehicle haulage from the runway to the Pole (two potential sites are considered), c) over-snow vehicle haulage from McMurdo across the Ross Ice Shelf, up the Skelton or another glacier, and over the polar plateau to the Pole, and d) vehicle haulage from some coastal station (located at about 67S latitude) with an easier access route onto the polar plateau. Pros and cons of these options are discussed and issues associated with each are identified. The feasibility and risk associated with each option are covered as well. Estimates of costs for many of the factors involved with each option allow financial comparison of each delivery scheme. (Auth. mod.)

SR93-20 ELECTRICAL PROPERTIES OF ICE.

Petrenko, V.F., Aug. 1993, 69p., ADA-270 432, Refs. p.65-69.

48-1000

ICE ELECTRICAL PROPERTIES, ICE PHYSICS, DIELECTRIC PROPERTIES, METAL ICE FRICTION, ANALYSIS (MATHEMATICS)

This report examines the electrical properties of ice in the frequency range of 0-10 megahertz, attempting to be suitable both as a simple and clear textbook for students and non-specialists and as a comprehensive review of recent developments and discoveries in the field. Corresponding to this double goal, the report consists of two parts. The first one is written in textbook style and contains most general theoretical and experimental results essential for understanding of unique electrical properties of ice. The theoretical interpretation of ice conductivity and ice dielectric permittivity is based on ice being a protonic semiconductor. Jaccard's elegant model is used to mathematically describe the electrical properties, and is expanded on cases of ice samples having finite size, boundaries and interfaces, and an inhomogeneous electric field. The statistics of charge carriers in pure and doped ice are discussed in detail, as are experimental techniques for measurements of conductivity and dielectric permittivity. The first part contains a comprehensive review of experimental results on ice conductivity, ice dielectric permittivity, mobility and electric charges of protonic charge carriers, and activation energies of their generation and motion. The second part includes more complicated physical phenomena: proton injection, dielectric crossover, ice field effect transistor, thermostimulated currents, theory of ice/metal interface, field extraction of charge carriers and a recombination injection.

SR93-21 MATHEMATICAL MODEL FOR OIL SLICK TRANSPORT AND MIXING IN RIVERS.

Shen, H.T., Yapa, P.D., Wang, D.S., Yang, X.Q., Aug. 1993, 71p., ADA-269 929, 44 refs.

48-724

MATHEMATICAL MODELS, OIL RECOVERY, OIL SPILLS, RIVERS, RIVER ICE

The growing concern over the impacts of oil spills on aquatic environments has led to the development of many computer models for simulating the transport and spreading of oil slicks in surface waters. Almost all of these models were developed for coastal environments. A few river models exist. These models only considered the movement of surface oil slicks. In this study a two-layer model, ROSS2, is developed for simulating oil spills in rivers. This model considers the oil in the river to consist of a surface slick and suspended oil droplets entrained over the depth of the flow. The oil transformation processes considered in the model include advection, mechanical spreading, turbulent diffusion and mixing, evaporation, dissolution, emulsification, shoreline deposition and sinking. The model can be

used for simulating instantaneous or continuous spills either on or under the water surface in rivers with or without an ice cover. The model has been implemented for the Ohio-Monongahela-Allegheny river system and the upper St. Lawrence River. This report describes the model formulation and implementation. A case study is presented along with detailed explanations of the program structure and its input and output. Although it is developed for simulating oil spills, the model can be applied to spills of other hazardous materials.

SR93-22 PROCEEDINGS.

International Symposium on Thermal Engineering and Science for Cold Regions, (formerly, the International Symposium on Cold Regions Heat Transfer), 4th, Hanover, NH, Sep. 28-Oct. 1, 1993, Lunardini, V.J., ed, Bowen, S.L., ed, 1993, 364p., ADA-270 636, Refs. passim. For individual papers see 48-858 through 48-897.

48-857

HEAT TRANSFER, ICE WATER INTERFACE, ICE FORMATION, ICE HEAT FLUX, ICE SOLID INTERFACE, FREEZING FRONT, FROZEN GROUND THERMODYNAMICS, SOIL FREEZING, PHASE TRANSFORMATIONS

SR93-23

ABSTRACTS.

International Symposium on the Ecological Effects of Arctic Airborne Contaminants, Reykjavik, Iceland, Oct. 4-8, 1993, Christie, S.J., ed, Martin, J., ed, Mello, J.E., ed, 1993, 138p., ADA-269 955.

48-796

POLAR ATMOSPHERES, AIR POLLUTION, ATMOSPHERIC CIRCULATION, ECOLOGY, ECOSYSTEMS, ENVIRONMENTAL IMPACT

SR93-24

EVALUATION OF PRE-EXTRACTION ANALYTICAL HOLDING TIMES FOR NITROAROMATIC AND NITRAMINE EXPLOSIVES IN WATER.

Grant, C.L., Jenkins, T.F., Golden, S.M., Aug. 1993, 13p., ADA-271 547, 18 refs.

48-999

EXPLOSIVES, CHEMICAL ANALYSIS

A study was conducted to experimentally evaluate the maximum acceptable pre-extraction analytical holding times (MHTs) for three nitroaromatic compounds and two nitramines in water. Three fortified waters (reagent-grade water, ground water and surface water) were utilized in the study. Analytes investigated were HMX, RDX, TNB, TNT and 2,4-DNT, all at the low microg/L level. Subsamples of each water sample were held for periods of 0, 3, 7, 14, 28 and 70 days at either room temperature (22 C) or under refrigeration (2 C). Samples were analyzed by RPHPLC without preconcentration. The two nitramines, HMX and RDX, were stable over the entire period for all waters under both storage temperatures. For the three nitroaromatics (TNB, TNT and 2,4-DNT) the results were very different. For the surface water, significant losses of TNB and TNT occurred in only a day or two, even under refrigeration. Loss of these analytes was accompanied by an increase in the concentration of their microbiological degradation products 3,5-dinitroaniline and 4-amino-2,6-dinitrotoluene, respectively. The rate of loss of 2,4-DNT was much slower in the surface water than for either TNB or TNT. The rates of loss of the three nitroaromatics were much slower in the reagent-grade water and ground water than in the surface water. The recommended MHT for nitroaromatics and nitramines in relatively sterile water samples is 50 days under refrigeration. Surface water samples, or samples likely to have significant microbial activity, should be preserved in the field prior to shipment or analyzed on-site, or the loss of TNB and TNT is likely to be significant. Concern is voiced over the use of organic solvents for fortification in holding time studies because of their potential for enhancement or suppression of microbiological degradation rates.

SR93-25

STRUCTURE OF ORDINARY ICE IH. PART 1: IDEAL STRUCTURE OF ICE.

Petrenko, V.F., Oct. 1993, 21p., ADA-275 149, 46 refs.

48-2534

ICE PHYSICS, ICE STRUCTURE, ICE MODELS, HYDROGEN BONDS, PHASE TRANSFORMATIONS, MATHEMATICAL MODELS, HEAVY WATER, ISOTOPES, OPTICAL ABSORPTION

This report examines the defect-free structure of ordinary Ih, reviewing experimental results and theoretical models of the arrangement of oxygen and hydrogen atoms and the electronic structure of ice. Special attention is given to the results of studies from the last two decades. Among the experimental techniques under consideration are X-ray diffraction, optical absorption, X-ray photoelectron spectroscopy and ultraviolet optical spectroscopy, nuclear magnetic resonance and electron spin resonance. The main subjects discussed are the chemical content of ice, the structure and properties of water molecules, hydrogen bonds, phase transitions, protonic disorder and electron energy spectrum of ice.

SR94-01

PRELIMINARY DEPTH-AGE SCALE OF THE GISP2 ICE CORE.

Meese, D.A., et al, Feb. 1994, 66p., ADB-183 805.

48-5407

ICE CORES, DRILL CORE ANALYSIS

This report contains a preliminary depth-age scale for the GISP2 core. An accurate depth-age scale is a prerequisite for comparison of this record to other climatic records and for the interpretation of other measurements from the core. An essentially continuous depth-age scale was obtained using parameters that yield characteristic annual layer signals, including visual stratigraphy, electrical conductivity measurements (ecm), stable isotopes and laser light scattering of dust. Additionally, known historical volcanic signals were identified in the core and used for tiepoints throughout the Holocene and in some cases deeper in the core. This report is for limited distribution until the data become available to the World Data Center.

SR94-02

VAPOR-FORTIFIED QA/QC SAMPLES FOR THE ANALYSIS OF VOLATILE ORGANIC COMPOUNDS.

Hewitt, A.D., Feb. 1994, 6p., ADA-278 712, 9 refs.

48-5408

SAMPLING, SOIL TESTS, SOIL POLLUTION

Vapor fortification is a precise treatment method for preparing soil subsamples for the analysis of volatile organic compounds (VOCs). This method of spiking is unique in that the fortification level is soil-type specific and the treatment mechanism is analogous to how soil in the vadose zone becomes contaminated by vapors from liquid VOC point sources. Soil subsamples treated by vapor fortification and sealed in glass ampoules until analysis have shown both good precision within batch and among batches, and analyte concentration stability for a month or longer. Vapor-fortified quality assurance/quality control (QA/QC) soils are more environmentally representative than soils fortified by liquid spiking procedures for the analysis of VOCs in vadose zone samples.

SR94-03

OPERATING MANUAL FOR HYBRID THERMOSYPHONS AT THE GAKONA POWER PLANT, ALASKA.

Haynes, F.D., Crory, F.C., Knuth, K.V., Quinn, W.F., Mar. 1994, 22p., ADA-279 068, 2 refs.

48-5409

FOUNDATIONS, PERMAFROST BENEATH STRUCTURES, THERMISTORS, INSULATION, COMPUTER APPLICATIONS, MANUALS

A power plant building was constructed in 1990 at an over-the-horizon radar site in Gakona, AK. Since it was built on permafrost, thermal protection between the building and the underlying permafrost was included in the design, which included rigid board insulation and hybrid thermosyphons placed in the gravel fill under the building. Soil temperature is monitored with eight thermistor strings placed under and at the building perimeter. This manual describes the steps that must be taken to ensure foundation stability, including directions on when to use the thermosyphons in the active mechanical refrigeration mode. A data acquisition system using a computer-controlled datalogger is described.

SR94-04

STRUCTURE OF ORDINARY ICE IH. PART II: DEFECTS IN ICE, VOLUME 1: POINT DEFECTS.

Petrenko, V.F., Whitworth, R.W., Apr. 1994, 35p., ADA-280 790, Refs. p.31-35.

48-5147

ICE PHYSICS, LATTICED STRUCTURES, DEFECTS, ICE ELECTRICAL PROPERTIES, ANALYSIS (MATHEMATICS), COMPUTERIZED SIMULATION, MODELS, OPTICAL ABSORPTION

This report examines point defects in ice: molecular defects (vacancies and interstitials), protonic point defects (ions and Bjerrum defects) and electronic point defects (solvated electrons and radicals). Experimental results and theoretical models of the defects' atomic and electronic structures, energies and mobilities are reviewed. Special attention is given to the results of studies from the last two decades. Among the experimental techniques under consideration are nuclear magnetic resonance, X-ray topography, electron spin resonance, measurements of ice conductivity and dielectric permittivity, spectra of optical absorption and photoluminescence, and measurements of diffusion coefficients of the oxygen and hydrogen isotopes in ice. Ab initio calculations, computer simulations, Jaccard's theory and soliton models are used to discuss the defect structures and their properties.

SR94-05

EVALUATION OF PRE-EXTRACTION ANALYTICAL HOLDING TIMES FOR TETRYL IN SOIL.

Jenkins, T.F., Apr. 1994, 8p., ADA-280 125, 20 refs.

48-5410

EXPLOSIVES, MILITARY RESEARCH, SOIL POLLUTION, LABORATORY TECHNIQUES

A study was conducted to experimentally evaluate the maximum acceptable pre-extraction analytical holding times (MHTs) for tetryl in soil. Three soils fortified with tetryl at the low microgram-per-

gram level were used in the study. Subsamples of each soil were extracted with acetonitrile in an ultrasonic bath after being held for 0, 1, 3 and 7 days at room temperature (22 C), under refrigeration (2 C) or frozen (-15 C). Extracts were analyzed by RP-HPLC. Tetryl concentrations in soils stored at room temperature and under refrigeration declined rapidly over the 7-day study period and several transformation products accumulated. After 7 days of storage at 2 C, tetryl concentrations were reduced by 46, 97 and 99% in the three soils studied. When the soils were frozen, there were no statistically significant analyte losses over the 7-day study period (95% confidence level). On the basis of the results of these experiments, the recommended MHT for soils containing tetryl is 7 days if kept frozen. Longer holding times may be possible, but they were not investigated here. Refrigeration is inadequate to prevent significant transformation of tetryl in soil samples being held for analysis. A question regarding the ability to use analyte-fortified soil to mimic field-contaminated soils in holding time studies is raised.

SR94-06

CONCENTRATION STABILITY OF FOUR VOLATILE ORGANIC COMPOUNDS IN SOIL SUB-SAMPLES.

Hewitt, A.D., Apr. 1994, 9p., ADA-280 124, 19 refs. 48-5411
DEGRADATION, SOIL POLLUTION, SOIL TESTS, SAMPLING

This study assesses the short-term (14- to 20-day) concentration stability of benzene, toluene, trans-1,2-dichloroethylene and trichloroethylene in soil matrices, in the absence of volatilization losses. Previous holding time studies failed to eliminate volatilization as a variable, making them difficult to interpret. Here, vapor-fortified soil subsamples, sealed in glass ampoules for 16 days, experienced appreciable reductions in benzene, presumably attributable only to biodegradation. Treated soil subsamples, on the other hand, prepared without vapor losses for either aqueous extraction headspace or purge-and-trap analyses, showed appreciable reductions in toluene and lost all the benzene over a 14-day holding period at 4 C. These findings suggest that chemical preservatives are necessary to maintain volatile organic compound concentrations in soil when more than a couple of days pass between collection and analysis.

SR94-07

ICE JAM DATA COLLECTION.

White, K.D., Zufelt, J.E., Mar. 1994, 37p., ADA-280 067, 28 refs.

48-5406

ICE JAMS, ICE BREAKUP, FRAZIL ICE, ICE COVER THICKNESS, DATA PROCESSING, SAFETY

Ice jam data collection is necessary to gain information on ice jam events, which may occur rarely and are often short-lived, but can at the same time cause large damage. An ice jam data collection program involves field data collection, review of existing hydrologic, hydraulic, meteorological, and ice records, and a search of historical records that may pertain to ice events. This report describes the development of an ice jam data collection program, the types of information to be collected, and techniques used in field ice jam data collection.

SR94-08

LOSSES OF TRICHLOROETHYLENE FROM SOIL DURING SAMPLE COLLECTION, STORAGE AND LABORATORY HANDLING.

Hewitt, A.D., Apr. 1994, 8p., ADA-280 972, 14 refs. 48-5149

SAMPLING, SOIL POLLUTION

The losses of trichloroethylene (TCE) from soil samples transferred to and from a storage bottle were evaluated by comparing them to values obtained using a method that limits sample disruption and exposure and prevents vapor losses from a subsample after a single transfer step. The results strongly suggest that volatile organic compounds (VOCs) are readily lost from contaminated soils when care is not taken to limit surface area exposure and prevent vapor loss. For this site investigation and others using similar sample handling protocols, VOC losses are most abundant during field collection operations and storage. The magnitude of the VOC losses during these two steps far exceeds those anticipated when a subsample is transferred from these storage bottles prior to off-site laboratory analysis.

SR94-09

EVALUATION OF THE USE OF SUPERCRITICAL FLUIDS FOR THE EXTRACTION OF EXPLOSIVES AND THEIR DEGRADATION PRODUCTS FROM SOIL.

Thorne, P.G., Apr. 1994, 10p., ADA-282 338, 35 refs. 48-5310

EXPLOSIVES, SOIL POLLUTION, CARBON DIOXIDE

The use of supercritical fluids to extract explosives and degradation products from soil was compared to SW846 Method 8330, which uses a sonic bath with acetonitrile as a solvent. Pure CO₂ and CO₂ with additional organic solvents were tried under various conditions of time, temperature and pressure. No conditions were found that extracted all of the analytes tested—TNT, TNB, RDX and HMX—with efficiency equal to the standard method. Since the time and solvent usage was greater using supercritical fluids than with solvent extraction, these fluids cannot be recommended as an alternative to acetonitrile.

SR94-10

EFFECT OF MATRIX STIFFNESS ON WAVY FIBER BEHAVIOR IN SINGLE-CARBON-FIBER-EPOXY COMPOSITES.

Madhukar, M.S., Dutta, P.K., Apr. 1994, 12p., ADA-280 970, 4 refs.

48-5150

COMPOSITE MATERIALS, POLYMERS, TENSILE PROPERTIES, LOW TEMPERATURE TESTS, STRESS STRAIN DIAGRAMS

This research identifies the mechanisms responsible for lowering the tensile strength of unidirectional polymer matrix composites at low temperatures. Since the stiffness of polymer matrices increases and toughness decreases when the temperature is lowered, the effect of low temperature was simulated by changing the matrix stiffness and toughness. Composite specimens containing a single carbon fiber embedded in an epoxy matrix were cast. The fibers were cast in curved geometries, and the specimens were loaded in tension. The fiber and interfacial failure processes were observed under polarized and unpolarized light through an optical microscope. Increasing the tensile load on the single fiber-epoxy specimens broke the embedded fiber into small fragments, whose lengths were smaller in the regions where the fiber was lying parallel to the loading axis. A significant fiber/matrix interfacial debonding, observed near the broken fiber ends in all specimens, was much more pronounced when the fiber was at an angle to the loading axis. Transverse tensile stresses at the interface caused this interfacial debonding. Specimens with higher matrix stiffness had long matrix cracks at the broken fiber ends, which were perpendicular to the fiber axis. These matrix cracks tend to propagate perpendicular to the fiber axis, increasing the composite's cold sensitivity. The major conclusions are as follows: 1) when fibers are wavy, they are not loaded to their full capacity because of premature interfacial debonding started by the interfacial shear stresses and transverse tensile stresses. The transverse tensile stresses at the interface are not present in the straight fiber specimens. 2) At higher stiffness and lower toughness values, the matrix cracks emanating at the broken fiber ends make the composite weaker. These two sources lower the strength of unidirectional composites at low temperatures.

SR94-11

COLD REGIONS PERFORMANCE OF OPTICAL-FIBER AND PULSED NEAR-INFRARED INTRUSION DETECTION SYSTEMS.

Peck, L., May 1994, 41p., ADA-282 211, 4 refs.

48-1542

COLD WEATHER PERFORMANCE, DETECTION, INFRA-RED EQUIPMENT

Four optical-fiber intrusion detection systems (IDSs) and one pulsed near-infrared IDS were operated from Oct. 1992 through July 1993 during conditions of snowfall and rainfall, unfrozen and frozen ground, snow as deep as 80 cm, wind gusts ≥ 20 m/s, and air temperatures ranging from -30 C to 35 C. The optical-fiber IDSs were installed in both buried and fence-mounted configurations. The detection capability of the IDSs was determined with controlled intrusions on a regular basis. Long-term monitoring identified causes of nuisance alarms.

SR94-12

STRUCTURE OF ORDINARY ICE I_h. PART II: DEFECTS IN ICE. VOLUME 2: DISLOCATIONS AND PLANE DEFECTS.

Petrenko, V.F., Whitworth, R.W., May 1994, 24p., ADA-282 628, Refs. p.21-24. For part II, vol.1 see

48-5147.

50-390

ICE PHYSICS, DEFECTS, MOLECULAR STRUCTURE, PLASTIC DEFORMATION, DISLOCATIONS (MATERIALS), DOPED ICE, ICE STRUCTURE

This report examines linear and planar defects in ice: dislocations, grain boundaries and stacking faults. The authors review experimental results and theoretical models on the defects' atomic structures and physical properties. In addition, experimental techniques used for direct observation of defects, experimental results and theoretical interpretation of dislocation mobility and the role of dislocations in plastic deformation are considered.

SR94-13

PRELIMINARY EVALUATION OF THE ANALYTICAL HOLDING TIME FOR WHITE PHOSPHORUS IN SURFACE WATER.

Walsh, M.E., Nadeau, B.M., May 1994, 8p., ADA-282 663, 19 refs.

48-5405

SURFACE WATERS, WATER POLLUTION, SAMPLING

A preliminary evaluation was made of the pre-extraction analytical holding time for white phosphorus in surface water samples. The purpose of the study was to determine the feasibility of shipping samples from a field site to a laboratory prior to extraction into an organic solvent. An initial screening study using spiked waters from four sources (reagent-grade water, well water, river water and salt marsh water) showed that white phosphorus was stable in the two surface waters for approximately one week provided precautions were taken to minimize losses to volatilization. Significant losses were observed in the reagent-grade water and the well water matrices. Following an ASTM standard, a holding time of six days was

determined for surface water samples maintained at 4 C.

SR94-14

FIELD SCREENING METHOD FOR TNT AND RDX IN GROUNDWATER.

Jenkins, T.F., Thorne, P.G., Walsh, M.E., May 1994, 12p., 27 refs.

49-704

EXPLOSIVES, GROUND WATER, SOIL POLLUTION, ENVIRONMENTAL IMPACT, MILITARY OPERATION

Two field screening methods were developed to determine TNT and RDX in groundwater. Both methods rely on solid phase extraction to remove analytes from the water and effect preconcentration. For the first method, a 500 mL water sample is passed through a 3 mL solid phase extraction cartridge packed with HaySep R. TNT and RDX are then eluted from the cartridge with acetone and the extract divided into two portions. One portion of the extract is reacted with acetic acid and zinc to convert RDX to nitrous acid. The nitrous acid is converted to an azo dye with a Griess reagent and the concentration estimated by the absorbance at 507 nm (Griess method). The second portion of the extract is reacted with a pellet of KOH and about 0.3 mg of sodium sulfite. The concentration of TNT is estimated from the absorbance at 540 nm of the Janowsky anion (Janowsky method). Using these methods, and visual detection of the colored solutions produced, samples containing 5 micrograms/L of either TNT or RDX can be reliably distinguished from uncontaminated water. In the second method, a 2-L water sample is passed through a stack of two 47 mm Empore SDVB disks to preconcentrate TNT and RDX. The top disk is removed, the bottom disk eluted with 5 mL of acetone and the extracted RDX determined using the Griess method described above. The top disk is then replaced and eluted with 20 mL of acetone and the extracted TNT determined by the Janowsky method described above. Using these methods and visual detection of the colored solutions, water samples containing 2 micrograms/L of either TNT or RDX can be reliably distinguished from uncontaminated water. For quantitative analysis, use of these methods and absorbance measurements with a spectrophotometer resulted in Method Detection Limits (MDL) of 0.9 micrograms/L for TNT, but a higher value of 3.8 micrograms/L for RDX. The higher MDL for RDX is caused by poor reproducibility in RDX recovery from the bottom membrane.

SR94-15

SORPTION OF TRACE-LEVEL ORGANICS BY ABS, FEP, FRE AND FRP WELL CASINGS.

Ranney, T.A., Parker, L.V., June 1994, 31p., 23 refs. 49-706

GROUND WATER, WELL CASINGS, WATER POLLUTION

The first part of this report contains the results of a literature review on whether four polymeric materials [acrylonitrile butadiene styrene (ABS), fluorinated ethylene propylene (FEP), fiberglass-reinforced epoxy (FRE) and fiberglass-reinforced plastic (FRP)] should be used in well casings when monitoring groundwater. The second part of this report contains the results of a laboratory study that compares sorption of low (mg/L) levels of dissolved organics by these four materials with sorption by two commonly used polymeric well casing materials [polyvinyl chloride (PVC) and polytetrafluoroethylene (PTFE)]. During the six-week laboratory study, ABS sorbed analytes much more rapidly and to a greater extent than the other materials, and PVC and FRE sorbed analytes the most slowly and to the least extent of the materials tested. As the study progressed there were an increasing number of unidentified peaks in the HPLC chromatograms of some of the samples. By the end of the study (1000 hours), there were 11 additional peaks in the ABS samples, 5 in the FRP samples and 1 in the FRE samples. Analysis by purge-and-trap GC/MS of the 1000 hour samples and 500 hour samples from a leaching study revealed the identity of some of these peaks.

SR94-16

ABRASIVE PROPERTIES OF TEST AND TRAINING SITE SOILS: RELATIVE HARDNESS OF FINE PARTICLE FRACTION.

Hogan, A.W., June 1994, 11p., ADA-285 240, 13 refs.

49-707

ABRASION, HARDNESS TESTS, SOIL MECHANICS, MILITARY EQUIPMENT

The experiment reported here shows that fine soil particles contribute to abrasion, wear and ultimate failure of parachute materials in a manner somewhat analogous to "three-body abrasion" in metals. The "hardness" of the particles collected at several test, training and maneuver areas is examined and scaled to known natural materials and commercial abrasives. The geometric diameters of the soil grains that enter and imbed in the fibers are primary factors for understanding the abrasion mechanism. In the case of cordage abrasion, the fraction of soil grains less than 0.2 mm was dominant within the strands and among the fibers. The particles were applied to designated surface grids on relatively large (3 x 3 to 7 x 7 cm) Mohs hardness specimens, glass photographic plates and steel cutting tools. All of the fine particles abraded glass photographic plates, with the exception of a soft, nonmagnetic, black fraction found in Camp Blanding fines. None of the materials scratched corundum, although it was possible to make a few scratches in Topaz with almost all specimens. The general upper limit of hardness was similar to that of quartz, which showed some detectable abrasion by five specimens. Fines from the Riyadh, Saudi Arabia, area easily scratched quartz, and this material is the hardest measured to date.

SPECIAL REPORTS

SR 94-17

ICE FORMATION IN AN ESTUARINE SALT MARSH, ALASKA.

Taylor, S., Racine, C.H., Collins, C.M., Gordon, E., June 1994, 14p., ADA-283 346, 9 refs.

49-5985

ESTUARIES, WETLANDS, ICE FORMATION, ICE GROWTH, ICE COVER EFFECT, BOTTOM SEDIMENT, WATER POLLUTION, SOIL POLLUTION, UNITED STATES—ALASKA—EAGLE RIVER FLATS

An extensive ice sheet builds up during the winter in a salt marsh complex at the mouth of Eagle River near Anchorage, AK. To clarify how snow accumulation, periodic tidal flooding, and freshwater flow contribute to the ice cover, ice cores were taken along a transect beginning at a deep pond along the edge of the salt marsh and traversing marsh, shallow pond, and mudflat areas. Ice structure, ice salinity, ice thickness, and presence or absence of sediment bands in the ice are described and were found to change markedly along the transect.

SR 94-18

FREZCHEM: A CHEMICAL-THERMODYNAMIC MODEL FOR AQUEOUS SOLUTIONS AT SUBZERO TEMPERATURES.

Marion, G.M., Grant, S.A., July 1994, 35p., ADA-288 456, 13 refs.

49-3264

THERMODYNAMICS, FREEZING, EVAPORATION, COMPUTERIZED SIMULATION, SOLUTIONS

This report documents a FORTRAN version of the Spencer-Møller-Weare chemical thermodynamic model for aqueous electrolyte solutions at subzero temperatures (FREZCHEM). FREZCHEM is structured to predict the chemical composition and unfrozen water of aqueous solutions between -60°C and +25°C at atmospheric pressure (0.101325 MPa). FREZCHEM includes two reaction pathways: 1) freezing at variable temperature and fixed total water and 2) evaporation at variable water and fixed temperature. Activity coefficients and the activity of water are calculated using the Pitzer equations, which are valid to high solution ionic strengths (~20 mol/kg). Fifteen chloride and sulfate salts of sodium, potassium, calcium, and magnesium are included in the model. Predicted and experimental measurements of solute molalities and the unfrozen water fraction during seawater freezing are in good agreement. At -50°C, 0.3% of seawater remains unfrozen with 99.7% of Na and 95.5% of Cl having precipitated into one of four salts. FREZCHEM should find many applications in physicochemical studies of aqueous solutions and freezing.

SR 94-19

CALGYP: A SIMULATION MODEL FOR CALCITE AND GYPSUM PRECIPITATION-DISSOLUTION IN SOILS.

Marion, G.M., July 1994, 39p., ADA-288 464, 21 refs.

49-3286

COMPUTERIZED SIMULATION, EVAPOTRANSPIRATION, PRECIPITATION (METEOROLOGY), RAIN, SOIL MECHANICS, FREEZE THAW CYCLES

This report documents the CALGYP model which is designed to simulate calcite and gypsum precipitation-dissolution in soils. CALGYP is a process model that is easy to parameterize, and is designed for long-term simulations (>1000 years). The CALGYP model has five components: soil parameterization, chemical thermodynamic relations, deterministic and stochastic rainfall models, an evapotranspiration model, and subroutines that calculate water, calcium, and sulfate fluxes through the soil. The stochastic rainfall model is based on probability distributions for interarrival times (days between rainfall events) and rainfall amounts and is designed to simulate the long-term mean annual rainfall and variability in annual rainfall for specific sites. The model is currently parameterized for seven climatic sites in the desert Southwest. However, climate (temperature and rainfall) can be altered and other minerals included, which makes the CALGYP model potentially applicable across a wider range of environmental conditions including freezing-thawing systems. A separate program, Rainmodule, is included to facilitate inclusion of new sites and to alter rainfall patterns for current sites. Instructions for utilization and a FORTRAN-77 source code listing are included.

SR 94-20

SCREENING FOR METALS BY X-RAY FLUORESCENCE SPECTROMETRY USING A SINGLE CALIBRATION STANDARD.

Hewitt, A.D., July 1994, 11p., ADA-286 425, 19 refs.

49-1563

SOIL POLLUTION, ENVIRONMENTAL TESTS, METALS, X RAY ANALYSIS

Analysis for copper, zinc, arsenic and lead was performed on a variety of solid particle matrices using a portable, high-resolution X-ray fluorescence (XRF) spectrometer. All quantitative determinations were based on an instrumental calibration method that uses a single certified reference material to establish elemental response factors and the Compton KA peak to normalize for matrix discrepancies. This simple approach to XRF analysis circumvents the need to acquire matrix-matched standards for either empirical coefficients or fundamental parameter methods of calibration. Preliminary results

show that response factor/Compton KA peak normalization is a promising approach when screening for these metals in soils, dust, paint chips and incinerated sludge.

SR 94-21

GRAVEL ROAD TEST SECTIONS INSULATED WITH SCRAP TIRE CHIPS: CONSTRUCTION AND FIRST YEAR'S RESULTS.

Eaton, R.A., Roberts, R.J., Humphrey, D.N., Aug. 1994, 41p., ADA-286 163, 5 refs.

49-1152

FROST HEAVE, TIRES, ROAD MAINTENANCE, ROADS, GRAVEL, INSULATION

A test project that uses tire chips as an insulating layer to limit frost penetration beneath a gravel-surfaced road is described. Tire chips, which are waste tires that have been cut into 2-in. pieces, are an attractive alternative to conventional insulation boards because they have moderate thermal resistance and are durable, free-draining and low cost. Furthermore, this application has the potential to make an important contribution to disposing of the more than 2 billion waste tires that are currently sitting in huge open piles across the U.S. The project was constructed in Richmond, ME, in Aug. 1992. It is 750 ft long, consisting of five sections with different thicknesses of tire chips and overlying soil cover and two control sections. Over 20,000 waste tires were used on this project. The primary goals were to determine the necessary thickness of tire chips to provide effective insulation and the minimum thickness of overlying soil cover needed to produce a stable riding surface. The thickness of the tire chip layers ranges from 6 to 12 in., while the thickness of the granular soil cover ranges from 12 to 24 in. The project is instrumented with thermocouples, resistivity gauges, groundwater monitoring wells and a weather station. In addition, the strength of the road surface is periodically measured with a heavy weight deflectometer. Results from the first year of service have shown that a 6-in. tire chip layer can reduce frost penetration by up to 25% and the gravel cover should be 12 to 18 in. thick to provide a stable riding surface.

SR 94-22

SURFACE OF ICE.

Petrenko, V.F., Aug. 1994, 37p., ADA-286 424, Refs. p.33-37.

49-1564

ICE SURFACE, ICE COVER THICKNESS, MOLECULAR STRUCTURE, ICE SINTERING, ICE PHYSICS, ICE MODELS, ICE ELECTRICAL PROPERTIES, PROTONS, BACKSCATTERING, NUCLEAR MAGNETIC RESONANCE, REGULATION, ICE ADHESION, ADSORPTION

This report examines the structure and physical properties of the surface of ice: a liquid-like layer on the ice surface, its thickness and molecular structure, surface conductivity, surface electric charge, surface potential, surface diffusion and so forth. The author reviews experimental results and theoretical models on ice adhesion, gas adsorption and ice sintering. Special attention is given to the results of studies from the last two decades. Among the experimental techniques under consideration are nuclear magnetic resonance, X-ray diffraction, optical ellipsometry, measurements of ice surface conductivity and dielectric permittivity, frictional electrification of snow and ice, proton channeling and others. In conclusion, theoretical models of the ice surface structure and the results of molecular dynamics are considered.

SR 94-23

INTERNATIONAL ASSOCIATION FOR HYDRAULIC RESEARCH WORKING GROUP ON THERMAL REGIMES: REPORT ON FRAZIL ICE.

Daly, S.F., ed, Aug. 1994, 43p., ADA-288 678, Refs. p.39-43.

49-3558

FRAZIL ICE, BOTTOM ICE, ICE CRYSTAL NUCLEI, ICE COVER, ICE PHYSICS, ICE MODELS, MATHEMATICAL MODELS, ICE CRYSTAL GROWTH

This report, prepared by members of the Working Group on Thermal Regimes of the Section on Ice Research and Engineering of the International Association for Hydraulic Research, is a comprehensive overview of frazil ice. Starting from the initial nucleation of single frazil ice crystals to the formation of ice covers that may be many kilometers long, the physics and evolution of frazil ice in natural water bodies are described. Laboratory experiments conducted over the last 30 years on frazil ice dynamics and other aspects of frazil are described and classified. A physically based quantitative model that describes the dynamic evolution of the crystal size distribution function is presented. In addition, the development of numerical models of frazil ice in oceans and rivers is discussed and their results described. This report serves as a review of the state of the art of the present understanding of frazil, and the extensive references are a comprehensive resource.

SR 94-24

SOLAR AND TERRESTRIAL RADIATION DATA FROM THE SLEEPERS RIVER RESEARCH WATERSHED: A SUMMARY REPORT.

Hardy, J.P., Aug. 1994, 25p., ADA-288 444, 37 refs.

49-2777

RADIATION MEASUREMENT, SOLAR RADIATION,

DATA PROCESSING, RADIATION MEASURING INSTRUMENTS, UNITED STATES—VERMONT

A long-term (24-year) database of solar and terrestrial radiation, as monitored in northern Vermont, has been compiled. This extensive database is a result of cooperative efforts among many government agencies. This report summarizes the present status of the solar and terrestrial radiation database, the instrumentation and calibration, and methods of data measurement, acquisition and analysis.

SR 94-25

UPPER-AIR DATA COLLECTED ON ICE STATION WEDDELL.

Claffey, K.J., Andreas, E.L., Makshtas, A.P., Aug. 1994, 61p., ADA-289 707, 23 refs.

49-3652

AIR ICE WATER INTERACTION, AIR TEMPERATURE, ATMOSPHERIC BOUNDARY LAYER, TEMPERATURE INVERSIONS, WIND VELOCITY, RADIO ECHO SOUNDINGS, DEW POINT, ANTARCTICA—WEDDELL SEA

From Feb. to June 1992, as Ice Station Weddell (ISW) drifted through the uncharted western Weddell Sea, the authors launched radiosondes, typically twice a day, to study the structure of the lower atmosphere. Here they describe the ISW radiosounding program, report on the availability of the data, and offer preliminary analyses of some of the atmospheric features observed. For 10 days in late May and early June, as the Russian icebreaker *Akademik Fedorov* approached ISW from the northeast to help remove the ice camp, simultaneous soundings were made four times a day from ISW and from the *Fedorov*. The authors also describe the radiosounding system on the *Fedorov*, report on the availability of these data, and present preliminary comparisons of the simultaneous ISW and *Fedorov* soundings. Soundings showed that temperature inversions were very common in this part of the Weddell Sea in fall and winter. Over 95% of the ISW soundings and 100% of the *Fedorov* soundings showed low-level temperature inversions. Of these, over 40% of the ISW soundings and over 67% of the *Fedorov* soundings were surface-based. A low-level jet in the wind speed profile was also common. Such a jet was found in almost 80% of the ISW soundings for which the authors had wind information. The jet core was usually between 25 and 75 m above the surface, with speeds in the core commonly between 4 and 10 m/s. (Auth.)

SR 94-26

CURRENT ISSUES IN ALASKA WETLAND MANAGEMENT.

Racine, C.H., Aug. 1994, 18p., ADA-286 427, Refs. p.14-18.

49-1565

WETLANDS, ENVIRONMENTAL PROTECTION, UNITED STATES—ALASKA

Although wetlands cover over half of Alaska, the status, management and regulation of these areas is problematic. The technical literature on Alaskan wetland vegetation, soils and hydrology is abundant, but the application of the literature to wetland management is poorly developed. This report identifies problems, issues and information gaps in the management of Alaskan wetlands. There are numerous arguments and debates on the designation, function and values, and disturbance of certain wetlands in Alaska. Permafrost, fire cycles and unique hydrologic regimes complicate the designation and delineation of Alaskan wetlands. The functions and values of most Alaskan wetlands clearly lie in their importance as habitat, particularly for migrating waterbirds, but an understanding of their role in flood water storage, water quality improvement, subsistence and other functions remains controversial and in need of study. Disturbance and other impacts on Alaskan wetlands is small relative to the large area that wetlands cover and in comparison with the loss of wetlands in the lower 48 states. However, several development projects in Alaska have affected large wetland areas and methods to restore these wetlands are being developed. Cumulative impacts are unknown, as are techniques for restoring permafrost wetlands containing gravel fill.

SR 94-27

SOFTENING OF RIGID PVC BY AQUEOUS SOLUTIONS OF ORGANIC SOLVENTS.

Parker, L.V., Ranney, T.A., Aug. 1994, 17p., ADA-286 374, 12 refs.

49-1562

POLYMERS, MONITORS, GROUND WATER

This research examined softening of rigid PVC by aqueous solutions of organic solvents known to be good PVC swelling agents. Significant changes in the hardness readings of rigid PVC exposed to aqueous solutions of methylene chloride (a good PVC swelling agent) occurred at thermodynamic activities as low as 0.1, which is much lower than has been reported or predicted. Rigid PVC became rubbery after exposure to 0.6-activity solutions of methylene chloride. Whether a similar phenomenon occurs with TCE, which is not as good a PVC swelling agent, is not clear from these preliminary studies. This study also looked at the effect of a mixture of several organic solvents dissolved in an aqueous solution. A solution that contained three good PVC swelling agents, each at an activity of 0.3, rapidly softened PVC (within 2 days). This indicates that there is some type of interactive or cumulative effect associated with mixtures of organic solutes, with each solute at an activity of 0.3 or higher. A study was also conducted to determine if aqueous solutions of a good PVC swelling agent that is also totally miscible in water (acetone) can soften PVC. After 1 week a concentration of 50% acetone softened PVC, while at 25% solution did not.

SR 94-28 VARIATION IN VISUAL AND NEAR-INFRA- RED CONTRAST WITH A SNOW BACK- GROUND.

Peck, L., Aug. 1994, 27p., ADA-289 710, 25 refs. 49-3653

ALBEDO, SNOW SURFACE TEMPERATURE, SNOW COVER EFFECT, SOLAR RADIATION, SNOW DEPTH, REFLECTIVITY, REFLECTION

Visual and near-infrared concealment against a snow cover are considered in terms of the daily and longer-term variation in albedo of a shallow (≤ 26 cm) snow cover. Examples of albedo of a Vermont snow cover demonstrate the influence of time of day (solar angle), incident solar radiation, snow depth, and snow wetness. Most albedos fell within the range 0.75-0.98. The most consistent variation was a decrease in albedo during the morning as the sun angle increased and corresponding increase with decreasing sun angle in the afternoon. Albedo was low when the snow surface temperature indicated melting was occurring or when an increase in temperature of the soil beneath the snow cover indicated solar radiation was being absorbed by the soil. Examples of the diurnal variation in sun angle and the seasonal variation in maximum potential solar radiation, as calculated from site latitude and longitude and calendar date, are presented.

SR 94-29 EFFECTS OF SEED TREATMENTS ON GERMI- NATION.

Diemand, D., Palazzo, A.J., Sharif, M., Sep. 1994, 20p., ADA-286 227, 12 refs. 50-5836

REVEGETATION, GRASSES, PLANT ECOLOGY, PLANTS (BOTANY)

The goal of this study was to identify ways to stimulate the germination of seeds of various grasses and legumes of potential value in revegetation of army training grounds or similar damaged lands. Ten treatments (including a control) were used on ten species of plants. Four of the treatments used plant hormones (kinetin and gibberellic acid), and five were environmental, including cold exposure, hot water soaks and cold water soaks. Of these the gibberellic acid treatments yielded the most spectacular results, increasing the germination rate more than three times that of the control in some cases. The environmental treatments were relatively ineffective, although the hot water soaks and the cold exposure often suppressed germination somewhat. Microbial contamination was much reduced by the hot water soak, which may be beneficial in some circumstances.

SR 94-30 LAYER COEFFICIENTS FOR NHDOT PAVE- MENT MATERIALS.

Janoo, V.C., Sep. 1994, 47p., ADA-288 262, 8 refs. 49-2778

BEARING TESTS, BITUMINOUS CONCRETES, ANALYSIS (MATHEMATICS), PAVEMENTS

In 1992, the New Hampshire Department of Transportation (NHDOT) experimented with the use of reclaimed asphalt concrete as a base course material, identified by NHDOT as reclaimed stabilized base (RSB). The RSB and a control test section were placed on Interstate 93 between exits 18 and 19. The RSB test section was designed to the same structural number (SN) as the control. To evaluate the structural capacity of these test sections, the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) conducted deflection tests using a Dynatest 8000 falling weight deflectometer (FWD). Preliminary analysis of the results by NHDOT personnel showed higher deflections in the reclaimed asphalt concrete test sections. The explanation was that the layer coefficient used for the RSB layer in the design was probably incorrect. A total of 10 test sections constituting the base course materials used by NHDOT were built near Bow, NH. CRREL evaluated and estimated the layer coefficients of the base course materials. The test program was developed to characterize the material in more than one way. Tests were conducted with the heavy weight deflectometer (HWD), dynamic cone penetrometer (DCP) and the Clegg hammer. In-situ California bearing ratio (CBR) tests were also conducted. The deflections from the HWD were used with the WESDEF back-calculation program to determine the layer moduli. The moduli were then used with the AASHTO Design Guide to calculate the layer coefficients. The layer coefficients were also determined with the method proposed by Rohde. The CBR values from the Clegg hammer, in-situ CBR and DCP tests were also used in the relationships in the HDM model to determine the layer coefficients.

SR 94-31 ESTABLISHMENT AND PERSISTENCE OF COOL- AND WARM-SEASON GRASSES ON SANDY SOILS.

Palazzo, A.J., Nov. 1994, 6p., ADA-289 462, 19 refs. 49-3654

GRASSES, REVEGETATION, COLD TOLERANCE, PLANTS (BOTANY), SANDS

This study investigated the establishment and early persistence of warm- and cool-season grasses sown on sandy soils in a cool, humid climate. Two studies, conducted with several cool-season fine fescue species (*Festuca* sp.) and the warm-season species Blackwell switchgrass (*Panicum virgatum* L.) and little bluestem (*Andropogon scoparius* Michx.), also looked at straw mulch as an aid for early establishment. The results show that the two warm-season grasses

and the cool-season fine fescue types have different growth habits, but all species are suitable for reducing erosion on coarse-textured soils containing more than 90% sand. The fine fescues established more quickly and produced a greater vegetative soil cover than little bluestem; they persisted for up to 3 years after seeding. Switchgrass, a warm-season grass, was taller and produced greater yields than the cool-season types. The straw mulch aided the establishment of the cool-season grasses. Both types of grasses are appropriate for revegetating sandy soils in a cool, humid climate.

SR 95-01 SUSCEPTIBILITY OF ABS, FEP, FRE, FRP, PTFE, AND PVC WELL CASINGS TO DEGRA- DATION BY CHEMICALS.

Ranney, T.A., Parker, L.V., Jan. 1995, 19p., ADA-294 734, 26 refs. 49-6271

WELL CASINGS, DEGRADATION, WELLS

This study compares the chemical resistance of four less commonly used materials for casing groundwater monitoring wells: acrylonitrile butadiene styrene (ABS), fluorinated ethylene propylene (FEP), fiberglass-reinforced epoxy (FRE), and fiberglass-reinforced plastic (FRP), with two more commonly used casing materials: polyvinyl chloride (PVC) and polytetrafluoroethylene (PTFE). The six materials were exposed to 28 neat organic compounds (including one acid) and to extremely acidic and alkaline conditions for up to 112 days. This was done to simulate some of the most aggressive environments that monitoring well casings may be exposed to. The casings were observed for changes in weight and signs of physical degradation (swelling, softening, decrease in strength, deterioration, or dissolution). As expected, the two fluorinated polymers (FEP and PTFE) were the most inert materials tested. They were not degraded by any of the test chemicals, although samples exposed to a few organic chemicals did show a slight weight gain ($\leq 1\%$). Among the nonfluorinated products tested, FRE was the most inert. Three organic chemicals caused particles to flake from the FRE surface, followed by separation of the glass fibers, and two organic chemicals caused weight gains exceeding 10%.

SR 95-02 WINTER TESTS OF ARTILLERY FIRING INTO EAGLE RIVER FLATS, FORT RICHARD- SON, ALASKA.

Collins, C.M., Calkins, D.J., Jan. 1995, 14p., ADA-298 512, 13 refs. 50-391

ENVIRONMENTAL IMPACT, MILITARY OPERATION, EXPLOSIVES, EXPLOSION EFFECTS, ICE COVER EFFECT, IMPACT TESTS

Winter tests of artillery firing were conducted in the Eagle River Flats impact range to determine the physical effects of exploding high-explosive (HE) projectiles on the ice-covered terrain. Eagle River Flats is an estuary at the mouth of the Eagle River used as the artillery impact range for Ft. Richardson. The Army suspended use of the impact range following the discovery that white phosphorus (WP) deposited in the salt marsh was responsible for large numbers of waterfowl deaths each summer. The purpose of these tests was to assess if seasonal firing of HE projectiles from 60- and 81-mm mortars and 105-mm howitzers into Eagle River Flats could be resumed without significantly disturbing the sediments contaminated with WP. The results of the test firings indicated that a minimum of 25 cm of ice over frozen sediment or a minimum of 30 cm of floating ice over shallow water was required to prevent disturbance of the WP-contaminated sediment by exploding 105-mm howitzer projectiles. Only 10 cm of ice was required to prevent disturbance by exploding 60- and 81-mm mortar projectiles.

SR 95-03 COLLABORATIVE STUDY OF SOILS SPIKED WITH VOLATILE ORGANIC COMPOUNDS.

Hewitt, A.D., Grant, C.L., Jan. 1995, 11p., ADA-292 695, 21 refs. 49-4467

SOIL POLLUTION, SOIL TESTS, WASTES, LABORATORY TECHNIQUES, ACCURACY

Vapor fortification is a method of spiking soils with volatile organic compounds (VOCs) that was recently developed for producing materials suitable for performance evaluation and quality assurance/quality control (QA/QC). Using this treatment method, soil subsamples enclosed in heat-sealed glass ampoules were distributed to 16 laboratories for a collaborative round-robin study. The sample sets consisted of duplicates of three different soils. Each soil subsample had been vapor-fortified with the following VOCs: trans-1,2-dichloroethylene (TDCe), trichloroethylene (TCE), benzene (Ben) and toluene (Tol). The laboratories were requested to report analyte concentration estimates for these four analytes and any other detected organic compounds after performing a methanol extraction, purge-and-trap gas chromatography, mass spectrometry analysis. The results from the 12 laboratories that met all of the design criteria produced a range of relative standard deviations from 8.5 to 28.2%, with a pooled standard deviation of less than 13%. The smallest range of consensus values was for Ben (pooled RSD=9.0%), while the determination of TDCe showed the greatest overall uncertainty (pooled RSD=20.3%). This round-robin effort confirmed that the use of vapor-fortified soils sealed in glass ampoules is a precise way of preparing and storing VOC-spiked soil subsamples.

SR 95-04 ASSESSING CRYOGENIC TESTING OF AGGREGATES FOR CONCRETE PAVEMENTS.

Korhonen, C.J., Charest, B., Feb. 1995, 12p., ADA-293 301, 7 refs. 49-5194

CONCRETE PAVEMENTS, COLD WEATHER CONSTRUCTION, CONCRETE DURABILITY, CONCRETE AGGREGATES, FREEZE THAW TESTS

Damage to concrete pavements caused by freeze-thaw deterioration of concrete aggregate remains a serious problem. Current tests for determining an aggregate's freeze-thaw durability can take up to 70 days to perform and results from these tests don't always correlate well with field performance. A rapid test for freeze-thaw durability that would accurately predict field service would be a valuable tool for providing durable concrete. Cycling aggregate 10 times between liquid nitrogen and hot water proved useful as a tool to rule out frost-susceptible aggregate. Pore size distribution measurements reveal pore sizes that are critical to freeze-thaw durability. Aggregates with more than 75% of their measurable pore volume between pore diameters of 0.01 and 5 μ m or with more than 95% of their measurable pore volume smaller than 5 μ m were susceptible to frost damage. Thus a new freeze-thaw test for aggregates might employ the cryogenic test to screen out all frost-susceptible aggregate and pore size measurement to classify the rest. This new test procedure offers results much quicker than current standard test procedures. Further study is needed to refine the method for general use.

SR 95-05 CHEMICAL PRESERVATION OF VOLATILE ORGANIC COMPOUNDS IN SOIL SUBSAM- PLES.

Hewitt, A.D., Feb. 1995, 8p., ADA-292 875, 23 refs. 49-5193

WASTE TREATMENT, HYDROCARBONS, PRESERVING, SOIL TESTS, LABORATORY TECHNIQUES

This study evaluates chemical preservation as a means of inhibiting the biological degradation of volatile organic compounds (VOCs) in soil subsamples held for 14 days or longer. Experiments were performed using a soil in which benzene and toluene were found to rapidly biodegrade under aerobic conditions while following protocols consistent with high-level and low-level purge-and-trap gas chromatography mass spectrometry and static headspace gas chromatography analysis. Chemical preservation consisted of immersing soil subsamples fortified with trans-1,2-dichloroethylene (TDCe), trichloroethylene (TCE), benzene and toluene in methanol or water acidified to a pH of less than 2 with NaHSO_4 . These two methods of chemical preservation resulted in stable concentrations of these two aromatic hydrocarbons even when held at room temperature. The two chlorinated hydrocarbons showed stable concentrations with or without chemical preservation. This result, in conjunction with earlier findings, suggests that chemical preservation is more effective at suppressing biodegradation than the current practice of refrigeration (4°C).

SR 95-06 INCORPORATION OF CRUDE AND FUEL OIL INTO SALT- AND FRESHWATER ICE.

Taylor, S., Perron, N., Feb. 1995, 11p., ADA-293 719, 15 refs. 49-5192

SALT ICE, OIL SPILLS, THERMAL CONDUCTIVITY, ICE WATER INTERFACE, ICE GROWTH, THIN SECTIONS, ICE MELTING

North Slope Crude, no.2 fuel oil, and vegetable oil were each released under columnar freshwater and saltwater ice grown in a laboratory coldroom. Because the thermal conductivity of all the oils is lower than that of water or ice, thinner ice grew under the oil and resulted in a concave ice/water interface. Both the fresh and saline ice encapsulated the oils, but the saline ice did so more slowly. Thin sections of the ice blocks containing the crude and fuel oils show how the columnar ice crystals bend around and under the oil patches. The movement of the vegetable oil during melting was photographed, and spectral reflectance measurements of the ice surface were made to determine if the oil could be detected remotely. Although the presence of oil under 10 cm of ice was detectable, under field conditions the optical detectability of oil will depend upon the depth of the oil within the ice, the type of ice, and the contrast between the under-ice oil and the background against which it is being viewed.

SR 95-07 DETECTION OF CREVASSES NEAR MCMURDO STATION, ANTARCTICA WITH AIRBORNE SHORT-PULSE RADAR.

Delaney, A.J., Arcone, S.A., Mar. 1995, 20p., ADA-295 072, 13 refs. 49-5750

CREVASSE DETECTION, AERIAL SURVEYS, PROFILES, RADIO ECHO SOUNDINGS, STRATIGRAPHY, ANTARCTICA—MCMURDO STATION

Airborne short-pulse radar is evaluated experimentally as a rapid reconnaissance tool for locating snow-bridged crevasses. An immediate need for a crevasse detector is present within the U.S. Antarctic Program, which is planning a major surface traverse from McMurdo to deliver construction materials to Amundsen-Scott Station. This feasibility study of a crevasse detection system was performed near

McMurdo Station in Jan. 1994. The radar utilized pulses centered near 200 and 500 MHz and was operated from a low flying helicopter with altitude and speed as variables. A global positioning system (GPS) was used for survey control. Results are presented over glacial ice on Ross I. and at various locations on the Ross Ice Shelf near White and Black Is. and near the Aurora Glacier terminus. Strong evidence of crevassing was recorded at flight speeds near 45 mph, at altitudes near 15 m, and at a data acquisition rate of 51 scans/second. Crevasses are detected by the reflections and diffractions from distorted layering in snow bridges, and by the strong diffractions from within the crevasses. The strongest diffractions apparently emanated from within the crevasse and not from the base of the snow bridge. Along the control line, a crevasse with no surface expression was detected by radar and verified by probing and digging. Transects devoid of crevasses show layering without the small scale distortion seen over snow bridges. (Auth. mod.)

SR95-08

ADDITIONAL STUDIES ON THE SOFTENING OF RIGID PVC BY AQUEOUS SOLUTIONS OF ORGANIC SOLVENTS.

Parker, L.V., Ranney, T.A., Mar. 1995, 17p., ADA-294 451, 12 refs. 49-5245

POLYMERS, PIPES (TUBES), SOLUTIONS

This study examined whether an aqueous solution that contained 18 organic chemicals that are either solvents or good swelling agents of PVC are able to cause softening when combined in a solution, with each solute at an activity of 0.05. This activity was selected because there is no evidence that an individual organic solute with an activity of 0.05 can soften PVC. However, the authors found that this combined test solution rapidly softened PVC. They also examined whether organic chemicals that are either solvents or good softening agents of PVC and are also totally miscible in water are able to soften PVC when mixed with water. Four chemicals (tetrahydrofuran, acetone, dimethylformamide and pyridine) were tested in a study that ran for 20 weeks. Tetrahydrofuran, a PVC solvent, caused a significant change in the hardness readings of samples exposed to concentrations as low as 0.01% (w/v). Acetone, a good swelling agent of PVC, caused a significant change in the hardness readings of samples exposed to a 10% concentration but not a 5% concentration. Dimethylformamide, a poorer swelling agent of PVC, did not cause any measurable signs of softening at concentrations below 60%. The lowest concentration of pyridine tested (20%) was found to have a significant effect on the hardness readings. A preliminary short-term study (7 days) showed that *n*-butylamine was intermediate between pyridine and dimethylformamide in its ability to soften PVC.

SR95-10

THERMAL DESIGN OF AN ANTARCTIC WATER WELL.

Lunardini, V.J., Rand, J.H., Mar. 1995, 98p., ADA-295 513, 22 refs. 49-6272

RESERVOIRS, WATER RESERVES, WELLS, COMPUTER PROGRAMS, MATHEMATICAL MODELS, COLD WEATHER PERFORMANCE, ANTARCTICA—AMUNDSEN-SCOTT STATION

The thermal and mechanical aspects of a potable water reservoir, formed at depth in a permanent snowfield in Antarctica, are detailed. The thermal model can be used for preliminary design, to predict reservoir size and depth, water temperature and mass, and energy requirements as a function of time. Predictions are made for the South Pole environment, but the model is valid for other permanent snowfields. The reservoir characteristics are influenced by the rate and timing of potable water removal during the lifetime of the reservoir. (Auth.)

SR95-11

DISPERSION-BY-CHEMICAL-REACTION TECHNOLOGY TO STABILIZE ASPHALT TAR, EARECKSON AIR FORCE STATION, SHEMYA, ALASKA.

Brar, G.S., Marion, G.M., Mar. 1995, 13p., ADA-298 862, 33 refs. 50-727

BITUMENS, SOIL POLLUTION, HYDRAULICS, SOIL WATER, PARTICLE SIZE DISTRIBUTION, WASTE TREATMENT, FREEZE THAW CYCLES

Many military installations have soil contamination, ranging from heavy metals to petroleum products. This report evaluates the Dispersion-by-Chemical-Reaction (DCR) technology to remediate soil contaminated by asphalt tar at Eareckson Air Force Station on Shemya I. in Alaska. The DCR technology uses patented hydrophobized CaO (lime) as the primary reagent for stabilizing heavy metals and organics in a relatively insoluble CaCO₃ matrix. Field work conducted at Shemya in Jan. 1994 showed DCR technology to significantly affect soil physical and chemical properties: moisture significantly decreased and temperature significantly increased during the mixing step (up to 95°C). The resultant product had a relatively low specific gravity and a coarse texture. Because of the coarse texture, the treated soils had high hydraulic conductivities. Reducing these for some applications will necessitate mixing with finer textured silts or clays. There were a few significant differences in chemical concentrations between DCR-treated and untreated soil, with the DCR-treated material generally having higher concentrations.

SR95-12

FREEZE-THAW PROCESSES AND SOIL CHEMISTRY.

Marion, G.M., Mar. 1995, 23p., ADA-295 688, Refs. p.18-23. 49-6273

FREEZE THAW CYCLES, FROZEN GROUND CHEMISTRY, SOIL CHEMISTRY, FROST HEAVE, FREEZING POINTS, UNFROZEN WATER CONTENT, DECOMPOSITION

This review broadly examines the interactions between freeze-thaw processes and soil chemistry, focusing on 1) the effect of solutes on physical properties such as freezing-point depression, unfrozen water and frost heaving, 2) the effect of freeze-thaw cycles and low temperatures on soil chemistry, and 3) modeling of freeze-thaw processes and chemistry. The presence of solutes causes a freezing-point depression, which increases the amount of unfrozen water in soils. Liquid films on soil particles provide the dominant route for the flow of water and associated solutes in frozen soils. In general, salts reduce the hydraulic conductivity and water flow to the freezing front, which reduces frost heaving. Solute exclusion during freezing leads to supersaturated solutions, which promotes the precipitation of secondary minerals in soils. At the watershed level, ionic concentrations in early meltwaters are often 2-9 times higher than snowpack concentrations. Temperature is the dominant factor controlling decomposition rates, with minimal detectable rates occurring at temperatures as low as -10°C; both bacteria and fungi are physiologically active at subzero temperatures.

SR95-13

ICE IMPACTS ON FLOW ALONG THE MISSOURI RIVER.

Wuebben, J.L., Daly, S.F., White, K.D., Gagnon, J.J., Tatinclaux, J.-C., Zufelt, J.E., Mar. 1995, 33p., ADA-294 570, 4 refs. For another version see 47-1237. 49-6274

RIVER ICE, ICE JAMS, HYDRAULICS, ICE COVER, RIVER FLOW, FLOW CONTROL, RESERVOIRS, ICE COVER EFFECT, UNITED STATES—MISSOURI RIVER

In recent years, drought conditions in the Missouri River basin have required more accurate control of releases at Gavins Point Dam, the furthestmost downstream flow control structure on the river, to meet competing water needs for irrigation and recreation upstream and for navigation and municipal and industrial water supply downstream. In winter, ice accumulations can seriously affect flow distribution along the river. This paper summarizes a study of such ice effects. It proposes methods to determine minimum flow releases at Gavins Point Dam to meet downstream water supply without unduly depleting upstream reservoirs.

SR95-14

RAPID SCREENING OF METALS USING PORTABLE HIGH-RESOLUTION X-RAY FLUORESCENCE SPECTROMETERS.

Hewitt, A.D., Apr. 1995, 13p., ADA-299 293, 20 refs. 50-1075

X RAY ANALYSIS, SOIL ANALYSIS, METALS, SOIL COMPOSITION, SOIL POLLUTION, REFRACTION, SPECTROSCOPY, SEDIMENTS

Analysis of copper, zinc, arsenic, lead, chromium, cobalt, nickel, mercury, thallium, selenium, silver, antimony, cadmium, tin, and barium was performed on soils and other particle matrices using two field-portable high-resolution X-ray fluorescence spectrometers (XRF). Quantitative determinations were based on fundamental parameter analysis and a second method that relies on analyte response factors and uses the Compton K α incoherent backscatter peak for matrix normalization. These two methods of instrumental analysis require only a few reference materials and are relatively insensitive to sample matrix composition. This study assessed the capability of these two rapid XRF analysis methods by determining metal concentrations in reference materials, field samples, and laboratory spiked soils. With the exception of nickel, cobalt, and chromium, concentrations within 50% of the expected values were consistently obtained at and below 1000 μ g/g.

SR95-15

ICE JAM FLOOD ASSESSMENT FOR THE ST. JOHN RIVER BASIN, AROOSTOOK COUNTY, MAINE.

Wuebben, J.L., Deck, D.S., Zufelt, J.E., Tatinclaux, J.-C., Apr. 1995, 22p., ADA-295 607, 4 refs. 49-6275

ICE JAMS, RIVER BASINS, FREEZEUP, ICE BREAKUP, ICE CONTROL, DAMS, WARNING SYSTEMS, UNITED STATES—MAINE—ST. JOHN RIVER, UNITED STATES—MAINE—AROOSTOOK RIVER

Ice jams occur almost every year on the Aroostook and St. John rivers in northern Maine. While most of these jams cause minor flooding or no flooding at all, ice jams have caused severe flooding six times in the last 20 years. In 1991 ice jams on the St. John River caused damage estimated at \$14 million. This report reviews field observations of the ice regime on the rivers and discusses possible mitigation measures—ice retention structures, channel modifications and early warning systems. In addition, since the 1991 ice jam caused water levels to rise so quickly that people were stranded in their homes, the development and installation of an ice jam motion

detection system is described. To aid in early warning, a system to predict the potential for ice jams and their severity that is based on a correlation of hydro-meteorological data with the ice regime is presented.

SR95-16

PRESERVATION OF WATER SAMPLES CONTAINING NITROAROMATICS AND NITRAMINES.

Jenkins, T.F., Thorne, P.G., McCormick, E.F., Myers, K.F., May 1995, 31p., ADA-295 723, 21 refs. 49-6276

EXPLOSIVES, CHEMICAL PROPERTIES, PRESERVING, WATER POLLUTION, CHEMICAL ANALYSIS, GROUND WATER, RIVERS

This study was conducted to develop a method for stabilizing water samples to be analyzed for nitroaromatic and nitramine explosives using SW846 Method 8330. Several options were tested using river water fortified with 15 nitroaromatic, nitramine, and aminonitroaromatic analytes. Acidification to pH2 using sodium bisulfate was selected based on its ability to retard microbiological and chemical transformations, its ease of use under field conditions, and its usability with both the direct and preconcentration procedures in Method 8330. Holding-time studies were performed over a 64-day storage period using fortified river water and groundwaters with and without chemical stabilization. Nonacidified samples showed rapid loss of tetryl, TNB, and TNT and slower loss of the dinitroaromatics. These losses were accompanied by increasing concentrations of transformation products. Losses of these nitroaromatics were completely eliminated by acidification to pH2. Nitramines were stable over the entire period whether samples were acidified or not. A small loss of the aminodinitroaromatics was observed for both acidified and unacidified samples. The rate of loss for acidified samples was initially greater than for nonacidified samples. Sample acidification caused no adverse effects on SW846 Method 8330, although samples to be preconcentrated using salting-out solvent extraction should be neutralized prior to extraction to prevent additional loss of aminodinitroaromatics.

SR95-17

NORTHERN SEA ROUTE RECONNAISSANCE STUDY: A SUMMARY OF ICEBREAKING TECHNOLOGY.

Sodhi, D.S., June 1995, 236p., 39 refs. For another source see 49-5678. 50-395

ICEBREAKERS, SHIPS, DESIGN, DESIGN CRITERIA, PROPELLERS, ICE NAVIGATION, PORTS, NORTHERN SEA ROUTE, RUSSIA

SR95-18

STRUCTURAL ICE CONTROL: REVIEW OF EXISTING METHODS.

Tuthill, A.M., July 1995, 31p., ADA-298 605, Refs. p.24-26. 50-393

ICE JAMS, RIVER ICE, ICE CONTROL, COUNTERMEASURES, ICE BREAKUP, ICE BOOMS, ICE DAMS, STRUCTURES, PIERS, ICE SOLID INTERFACE

This report is a comprehensive review of structural ice control methods in worldwide use today. The structures are grouped according to the purpose of the ice control. Categories are sheet ice retention, breakup ice control and ice diversion. The focus is on the recent performance of the structures. Innovative solutions that could be applied to river confluence ice problems also receive special attention. The report reviews the state of the art in structural ice control, addressing the ranges as well as the limits of application of methods in use today.

SR95-19

ROOF BLISTERS: CAUSE AND CURE.

Korhonen, C.J., Charest, B., July 1995, 10p., ADA-298 686, 5 refs. 50-394

ROOFS, WINTER MAINTENANCE, VENTILATION, COUNTERMEASURES

Blisters are a major problem of built-up roof membranes. They are caused by voids built into the roof during construction. They develop into the characteristic dome-shaped humps by a breathing action driven by thermal cycling. A small pressure relief vent was patented by CRREL as a cost-effective way to repair blisters. Though these vents cannot prevent blisters from forming, they can lengthen a roof's service life by repairing the blisters before they break. Two demonstration projects were conducted to transfer the blister vent technology to the military community. Most participants in the demonstration projects found the vent easy to use and that it performed as designed. The main objection to the vent was its price.

SR95-20

DEVELOPMENT OF A FIELD METHOD FOR QUANTIFYING AMMONIUM PICRATE AND PICRIC ACID IN SOIL AND WATER.

Thorne, P.G., Jenkins, T.F., Aug. 1995, 22p., ADA-300 235, 36 refs. 50-1152

SOIL POLLUTION, WATER POLLUTION, MILITARY

OPERATION, IONS

Methods for the detection and quantification of ammonium picrate and picric acid in soil and water were developed. Picrate ions were extracted from water directly or from acetone extracts of soil by solid-phase, acidic, ion-exchange materials. Elution from the ion exchangers was accomplished by converting the retained picrate to picric acid using strong aqueous, acid-organic solvent mixtures. The resulting colorless solution was then converted back to a colored picrate solution by dilution with water. Quantification and correction for background interferences were based on spectrophotometric measurements. A colorimetric, chemical confirmation of picrate was possible for the water method. The method detection thresholds were determined to be 1.3 µg/g for soil and 3.6 µg/L for water. Both methods can be implemented under field conditions.

SR95-21

AUTOMATION OPPORTUNITIES AT CORPS OF ENGINEERS LOCKS AND DAMS.

Carey, K.L., Sep. 1995, 25p., ADA-300 664.
50-1518

NAVIGATION, LOCKS (WATERWAYS), DAMS, COMPUTER APPLICATIONS

In an investigation to determine the feasibility of automating some of the operations at navigation locks and dams of the Corps of Engineers, a scheme of five categories composed of seventeen characteristics was developed to evaluate candidate automation measures. As a result of both a survey of Corps water resources projects and field visits to seven lock and dam projects, 43 navigation project functions that could be automated to varying degrees are identified and described (24 associated with lock operations, 15 associated with dam operations, and four related to navigation operations). The 43 project functions are assessed according to the evaluation scheme, and presented in a matrix format. The matrix can be used for selections, comparisons, sortings, or rankings, of the various project functions and automation alternatives. The matrix is readily adaptable to a database when and if it grows larger. Thus, an initial framework has been established for evaluating operations and functions commonly occurring at navigation locks and dams offering opportunities for automation. This framework should prove useful for operational planning and management decision-making.

SR95-22

EVALUATION OF CLEAN SOLID PHASES FOR EXTRACTION OF NITROAROMATICS AND NITRAMINES FROM WATER.

Jenkins, T.F., Thorne, P.G., Myers, K.F., McCormick, E.F., Parker, D.E., Escalon, B.L., Sep. 1995, 15p., ADA-301 300, 22 refs.
50-1977

SOIL POLLUTION, WATER POLLUTION, EXPLOSIVES, SEDIMENTS, GROUND WATER, LEACHING, SOIL TESTS, SAMPLING, CHEMICAL ANALYSIS, ENVIRONMENTAL TESTS, SOLID PHASES, FILTERS, IMPURITIES
Salting-out solvent extraction (SOE) was compared with cartridge and membrane solid-phase extraction (SPE) for preconcentration of nitroaromatics, nitramines, and aminonitroaromatics prior to determination by reversed-phase high-performance liquid chromatography. The solid phases used were manufacturer-cleaned materials: Porapak RDX for the cartridge method and Empore SDB-RPS for the membrane method. Thirty-three groundwater samples from the Naval Surface Warfare Center, Crane, IN, were analyzed using the direct analysis protocol specified in SW846 Method 8330, and the results were compared with analyses conducted after preconcentration using SOE with acetonitrile, cartridge-based SPE, and membrane-based SPE. For high-concentration samples, analytical results from the three preconcentration techniques were compared with results from the direct analysis protocol; good recovery of all target analytes was achieved by all three preconcentration methods. For low-concentration samples, results from the two SPE methods were correlated with results from the SOE method; very similar data was obtained by the SOE and SPE methods, even at concentrations well below 1 µg/L. The large chromatographic interferences observed for the SPE methods in an earlier study using less clean materials were largely absent here. A small interference was observed for both SPE methods at the retention time of RDX on the primary analysis column that translated to concentrations ranging from 0.2 to 0.6 µg/L RDX. Detection limits for RDX should be raised to 0.6 µg/L if the SPE methods are used for preconcentration due to this potential interference. The authors recommend that solid-phase extraction be included as an option in SW846 Method 8330 as well as SOE.

SR95-23

ESTIMATED SNOW PARAMETERS FOR VEHICLE MOBILITY MODELING IN KOREA, GERMANY AND INTERIOR ALASKA.

Horrigan, T., Bates, R.E., Sep. 1995, 7p., ADA-301 154, 11 refs.
50-2708

SNOW VEHICLES, COLD WEATHER PERFORMANCE, SNOW COVER EFFECT, TRAFFICABILITY, SNOW PHYSICS, CLASSIFICATIONS, SNOW DENSITY, SNOW DEPTH, METEOROLOGICAL FACTORS, SEASONAL VARIATIONS, FORECASTING, KOREA, GERMANY, UNITED STATES—ALASKA

Snow is a crucial factor affecting the U.S. Army's operations in cold regions. Values for snow depth and snow density are needed for vehicle mobility studies, but unfortunately the available historical

records of these parameters tend to be relatively sparse. This report deals with the estimation of snow density and snow depth from readily available parameters such as air temperature and wind speed. As a basis for further study, the authors have summarized previous work in three areas of particular interest to the U.S. Army's vehicle mobility programs: Korea, Germany, and Alaska. Empirical models are presented for estimating snow parameters in these regions.

SR95-24

SOIL FREEZE-THAW EFFECTS ON BANK ERODIBILITY AND STABILITY.

Gatto, L.W., Sep. 1995, 17p., ADA-301 818, 61 refs.
50-2706

BANKS (WATERWAYS), FROZEN GROUND MECHANICS, SOIL EROSION, STABILITY, SOIL STRENGTH, SOIL STRUCTURE, SOIL WATER MIGRATION, GROUND ICE, SEASONAL FREEZE THAW, THAW WEAKENING, FROST HEAVE, FREEZE THAW CYCLES, SEASONAL VARIATIONS

When air temperature is below ground temperature, a thermal gradient is established in the soil that causes the soil to lose heat to the atmosphere. When the soil has lost sufficient heat for soil water to freeze, the newly formed ice changes soil structure by disaggregating, separating, and reorienting soil particles. The suction set up within the freezing soil draws water to the freezing zone through the film of unfrozen water surrounding soil particles, supplying additional water for freezing, so the volume of ice increases. When appropriate thermal and water supply conditions are in place, disseminated ice lenses can form in the soil. As the ice lenses grow, the soil surface is heaved in the direction of heat flow from the soil. In this weakened state, thawed bank soils are usually more easily eroded by raindrop impacts, overland flows, river and lake ice forces, currents and waves, and are highly susceptible to mass failures. In some instances newly thawed soils are weaker than at any other time of the year. Some studies show that processes related to bank soil freezing and thawing cause more bank recession annually than other processes in areas where seasonal frost forms. However, with time, the strength of the thawed soil returns as excess water drains from the soil, and soil particle packing and interlocking increase. Therefore, frost-induced reductions in soil strength and soil particle displacements must be included in bank migration and bank erosion models to be applied in regions with seasonal soil frost.

SR95-25

SIMPLE FIELD SCREENING METHOD FOR WHITE PHOSPHORUS (P₄) IN SEDIMENT.

Walsh, M.E., Racine, C.H., Collins, C.M., Bouwkamp, C., Thorne, P.G., Oct. 1995, 8p., ADA-311 992, 10 refs.
50-2328

SEDIMENTS, SOIL POLLUTION, SOIL CHEMISTRY, WATER POLLUTION, WATER CHEMISTRY, CHEMICAL ANALYSIS, EXPLOSIVES, ENVIRONMENTAL IMPACT, UNITED STATES—ALASKA—EAGLE RIVER FLATS
A simple field screening method to detect white phosphorus particles in sediment is described. A thin layer of wet sediment is heated until all water evaporates. The presence of white phosphorus is indicated by visual detection of the inflammation of white phosphorus particles that occurs at relatively low temperatures (less than 40°C) once a protective layer of water is removed. The field screening method consistently gave positive results for samples where solvent extraction followed by gas chromatography indicated white phosphorus concentrations above 1 microg/g. A more sophisticated method, based on solid-phase microextraction and gas chromatography determination, was also tested. Concentrations less than 1 microg/kg were detectable.

SR95-26

ENHANCED PRESERVATION OF VOLATILE ORGANIC COMPOUNDS IN SOIL WITH SODIUM BISULFATE.

Hewitt, A.D., Nov. 1995, 15p., ADA-302 930, 21 refs.
50-2566

SOIL POLLUTION, PRESERVING, LABORATORY TECHNIQUES, SOIL ANALYSIS

Sodium bisulfate (NaHSO₄) was evaluated as a means of chemically preserving soil samples to prevent the microbiological degradation of volatile organic compounds (VOCs). Laboratory sample treatment consisted of spiking soil samples held in glass ampoules with aqueous solutions containing eight different VOCs or gasoline and then sealing them to eliminate volatilization. Samples preserved with NaHSO₄ were held at room temperature (22°C), while equal numbers of unpreserved samples were stored refrigerated (4°C) and at room temperature. Results show that concentrations of all of the halogenated hydrocarbons tested (14) remain fairly constant, independent of temperature or preservation. In contrast, all the aromatic hydrocarbons (10) tested as separate analytes, or ones that could easily be identified in gasoline, experienced a complete (>95%) loss when held for nine days at room temperature. Refrigeration reduced the rate of biodegradation, but two aromatic hydrocarbons showed substantial losses (>80%) within the currently recommended 14-day holding period. Over a 28-day refrigerated period, reductions of greater than 95% occurred for 9 of 10 aromatic hydrocarbons tested. With the exception of styrene, chemical preservation by introducing NaHSO₄ mitigated the loss of all of aromatic hydrocarbons tested over a 28-day holding period when samples were stored at room tem-

perature. Therefore, NaHSO₄ preservation is one way of effectively eliminating biodegradation of VOCs in soil samples intended for low level (<1 µg/g) analysis.

SR95-27

SILT FENCE TESTING FOR EAGLE RIVER FLATS DREDGING.

Henry, K.S., Hunnewell, S.T., Dec. 1995, 12p., ADA-304 936, 8 refs.
50-880

DREDGING, MILITARY OPERATION, ENVIRONMENTAL IMPACT, GEOTEXTILES, FILTERS, UNITED STATES—ALASKA—EAGLE RIVER FLATS

An estimated 1,000 to 2,000 waterfowl deaths have been noted annually since 1980 in Eagle River Flats (ERF), AK, an artillery impact area used by the Army. Waterfowl die because of the ingestion of unburned white phosphorus (WP) particles deposited by incendiary. Remediation of the site is currently being planned, and one of the techniques being considered is the use of a remote-control dredge to excavate WP-contaminated sediment. Dredged material will be placed into a settling pond and allowed to settle until a clear layer of water forms on the top of the sediments. The water will then be released over a weir, across a concrete pad, through a geotextile silt fence to a drain into the ERF. This report describes tests that were conducted to evaluate how well candidate geotextiles for the silt fence retained small particles (d<1 mm) that were suspended in water being released back into the ERF. The soil used in the tests was collected from ponds to be dredged. The testing program consisted of two parts. Part I tests were standard engineering tests for silt fences, and were used to select a product for further testing. Part II tests simulated field conditions and were conducted to determine whether the candidate geotextile selected was likely to perform well. In the tests that simulated field conditions, those that used geotextiles achieved system filtering efficiencies of 99%, and the geotextile filter reduced the final total suspended solids contained in the water by a factor of 10. Negligible amounts of soil passed the #200 sieve from water that flowed through the geotextile. However, it is also noted that allowing the sediment to settle before decanting the water resulted in system filtering efficiencies in excess of 90% when a silt fence was not used in the test. Due to differences between lab and field use of this product, several recommendations are made to help ensure the proper functioning of the geotextile when used in Eagle River Flats.

SR95-9

PROCEEDINGS.

International Conference on Cold Weather Military Operations, Burlington, VT, Feb. 28-Mar. 2, 1995, Collins, N.H., ed, 1995, 305p., ADA-294 630, Refs. passim. For selected papers see 49-5774 through 49-5786.

49-5773

MILITARY OPERATION, COLD WEATHER OPERATION, COLD WEATHER PERFORMANCE, COLD WEATHER TESTS, MILITARY EQUIPMENT, CLOTHING, DESIGN, DESIGN CRITERIA, COLD EXPOSURE, TEMPERATURE EFFECTS

SR96-01

ICE JAM FLOODING AND MITIGATION: LOWER PLATTE RIVER BASIN, NEBRASKA.

White, K.D., Kay, R.L., Jan. 1996, 86p., ADA-305 756, 40 refs.
50-4251

ICE JAMS, FLOODING, RIVER ICE, COUNTERMEASURES, FREEZEUP, DATA PROCESSING, ICE BREAKUP, DUSTING, ICE MODELS, RIVER FLOW, UNITED STATES—NEBRASKA—PLATTE RIVER

This report presents the results of the Corps of Engineers' Section 22 study of ice jam flooding in the Lower Platte River basin. The purpose of the study was to gather and analyze historical data relating to ice jams, with the intent of developing guidance that can be used to alleviate ice jam flooding at seven sites within the study area. Ice event and related information is summarized for each site. Ice event characteristics for the study area are identified and analyzed. A model for predicting the occurrence of ice jams or other ice events within the study area was developed based on data for the Platte River at North Bend, NE. The model provides the minimum discharge associated with ice events for a given date, assuming a threshold value of accumulated freezing degree-days has been reached. A data collection program for future field observations was developed and placed in operation during the winter of 1993-94. General information on ice jam mitigation measures, as well as specific information on such operations as dusting and blasting, is provided. Specific recommendations include increased monitoring of ice conditions, installation of ice motion detectors and water stage recorders, and further study of nonstructural and structural mitigation measures.

SR96-02

ELECTROMECHANICAL PHENOMENA IN ICE.

Petrenko, V.E., Feb. 1996, 30p., ADA-306 811, Refs. p.27-30.
50-4546

ICE ELECTRICAL PROPERTIES, ICE MECHANICS, ICE PHYSICS, ICE CRACKS, DIELECTRIC PROPERTIES, ICE ELASTICITY, ICE CREEP, ICE DEFORMATION

This report examines the electromechanical effects in ice. This group of physical phenomena, which has been found and studied relatively recently, broadens basic knowledge of ice and may have some practical applications. The electromechanical phenomena in this report are separated into three groups: 1) effects in which electromagnetic fields are generated by means of mechanical actions such as elastic stress, plastic strain, fracture or friction; 2) effects in which an application of electric fields modifies such mechanical properties of ice as its plasticity, elasticity and friction; 3) effects in which plastic strain changes electrical conductivity or dielectric permittivity of ice. Experimental results and theoretical models are discussed and some possible practical applications suggested.

SR 96-03

SAMPLING TRACE-LEVEL ORGANICS WITH POLYMERIC TUBINGS.

Parker, L.V., Ranney, T.A., Feb. 1996, 31p., ADA-309 086, 30 refs.
50-5672

PIPES (TUBES), PLASTICS, LEACHING, GROUND WATER

There is concern whether tubings used to sample groundwater can affect contaminant concentrations. Tubings might sorb contaminants, thereby giving falsely low values, or they might leach contaminants, thereby giving falsely high values. There also is concern that a tubing used previously in a well with high concentrations of contaminants might subsequently desorb contaminants into samples taken from other wells if decontamination is insufficient. The review of the literature indicated that these concerns are valid, although a comprehensive study of this subject does not exist. In the laboratory study, the authors looked for sorption of a suite of organic solutes by 20 polymeric tubings under static conditions. Seven of these tubings were flexible and the others were rigid. The authors found that among the rigid tubings tested, the three fluoropolymers (fluorinated ethylene propylene [FEP], FEP-lined polyethylene, and polyvinylidene fluoride [PVDF]) were the least sorptive tubings. However, even these tubings readily sorbed some of the analytes. Among the flexible tubings tested, a fluorocopolymer tubing and a tubing made of a copolymer of vinylidene fluoride and hexafluoropropylene (PVDF-HFP) were the least sorptive. It was also found that several of the 20 tubings appeared to leach constituents into the test solution. The authors were unable to detect any evidence that constituents leached from the polyethylene tubings, the rigid fluoropolymer tubings, and one of the plasticized polypropylene tubings. Currently, studies are under way to see whether the effects observed in this study increase, decrease, or remain the same under dynamic conditions.

SR 96-04

OBJECT-GAWSER: OBJECT-ORIENTED GUELPH ALL-WEATHER STORM-EVENT RUNOFF MODEL. PHASE 1: TRAINING MANUAL; APPLICATION OF OBJECT-ORIENTED SIMULATION TO HYDROLOGIC MODELING.

Hinckley, J.A., Jr., Feb. 1996, 55p., ADA-306 827, 14 refs.
50-4545

HYDROLOGY, WATERSHEDS, COMPUTER PROGRAMS, COMPUTERIZED SIMULATION, SNOWMELT, RUNOFF, SNOW DEPTH, SNOW WATER CONTENT, SNOWFALL

Hydrologic models are currently used to understand the economic and ecological impacts of hydrologic processes. A new hydrologic model entitled Object-GAWSER was designed using an object-oriented platform to provide new insights into watershed hydrology. Object-GAWSER is a temperature index model that simulates upland watershed hydrology. Object-GAWSER is different from other hydrologic models in that each one of its components can be easily studied to understand its sensitivity to various inputs. First, this report will show how Object-GAWSER can be used to simulate the hydrologic behavior of forested, agricultural, and suburban watersheds. Second, the report will describe how Object-GAWSER was designed.

SR 96-05

OBTAINING AND TRANSFERRING SOILS FOR IN-VIAL ANALYSIS OF VOLATILE ORGANIC COMPOUNDS.

Hewitt, A.D., Lukash, N.J.E., Feb. 1996, 10p., ADA-306 918, 21 refs.
50-4547

SOIL ANALYSIS, SOIL TESTS, SAMPLING, LABORATORY TECHNIQUES

The ability to retain volatile organic compounds (VOCs) while collecting and transferring intact soils for in-vial analysis was evaluated with field and laboratory samples. Experiments were designed to assess if VOC concentrations are maintained in an intact soil sample when 1) held for under an hour in a metal core liner, 2) held for days in a metal core liner sealed with TFE-fluorocarbon sheets or aluminum foil (ASTM D4547-91), 3) transferred to an empty vial to which a solvent was added later. Results indicate that these procedures are all highly susceptible to volatilization losses. To maintain site-representative VOC concentrations, collection of soil samples for in-vial analysis should occur within minutes of exposing a fresh surface by using a device that limits soil structure disruption and exposure.

SR 96-06

ICE FORCE AND SCOUR INSTRUMENTATION FOR THE WHITE RIVER, VERMONT.

Zabilansky, L.J., Apr. 1996, 54p., ADA-310 412, 15 refs.
50-6073

RIVER ICE, ICE BREAKUP, ICE SCORING, FLOW MEASUREMENT, BRIDGES, PIERS, ICE SOLID INTERFACE, IMPACT STRENGTH, HYDROGRAPHY, SENSORS, MEASURING INSTRUMENTS, SEDIMENT TRANSPORT, BOTTOM TOPOGRAPHY

In Jan. 1990 a bridge over the White River in White River Junction, VT, collapsed during a period of ice breakup. The ultimate failure was attributed to the progressive deterioration of the foundation due to scour. Twenty years of weather and stage data at the site are presented along with a failure scenario. Instrumentation to measure the ice forces on a bridge pier was incorporated into the design of the replacement bridge. Since scour was the primary cause of failure, the new bridge piers have extensive scour protection. A pier for a bridge 2000 feet upstream of the new bridge was instrumented for scour. The objective was to develop real-time scour monitors that would survive ice and debris and allow correlation between the hydrograph and scour activity. Instrumentation and data acquisition packages for both instrumented bridge piers are presented. The results of the first two years of measurements are presented. The bulk of the scour occurred in the initial stages of breakup while the ice sheet was still intact. Apparently to compensate for the fixed ice surface, the mean velocity has to increase as the discharge increases. The faster velocity resulted in more aggressive bed scour. Once the ice sheet broke up and the ice was free floating, the scour activity subsided.

SR 96-07

DUSTING RIVER ICE WITH LEAF MULCH TO AID IN ICE DETERIORATION.

Hachnel, R.B., Clark, C.H., Taylor, S., Apr. 1996, 19p., ADA-310 083, 17 refs.
50-6072

RIVER ICE, ALBEDO, ICE CONTROL, ICE MELTING, DUSTING, SEDIMENTS, PLANT TISSUES, ICE DETERIORATION, ENVIRONMENTAL PROTECTION, HYDRAULIC JETS

In an effort to find a low cost means of reducing ice jams on small rivers in New England, dusting with organic matter was field tested during the spring of 1993 and 1994. Test squares on a pond located at CRREL in Hanover, NH were dusted with several materials to evaluate their effectiveness in accelerating snow melting and ice deterioration. Leaf mulch was included in the materials tested because, unlike other materials used in the past to weaken ice (e.g., fly ash or coal slag), leaves are naturally found in rivers and should not adversely affect aquatic organisms when applied in small quantities. It was found from these tests that the leaves perform about the same as the traditionally used dusting materials. To transfer what was learned at the pond tests to a field application, two rivers in Vermont, with a known history of ice jams, were dusted using leaf mulch during the spring of 1994. More work is needed to determine the effectiveness of leaf mulch to weaken ice and how much ice weakening is necessary to reduce the severity of ice jams.

SR 96-08

SORPTION AND LEACHING OF TRACE-LEVEL METALS BY POLYMERIC WELL CASINGS.

Ranney, T.A., Parker, L.V., Apr. 1996, 15p., ADA-310 392, 33 refs.
50-5911

PLASTICS, WELL CASINGS, GROUND WATER, LEACHING, METALS

The most commonly used well casing materials (polyvinyl chloride [PVC], polytetrafluoroethylene [PTFE] and stainless steel) cannot be used for all monitoring applications. Therefore, a series of experiments was conducted to compare three alternative polymeric well casing materials (fluorinated ethylene propylene [FEP], fiberglass-reinforced epoxy [FRE] and fiberglass-reinforced plastic [FRP]) with PVC and PTFE. These studies were conducted to determine the overall suitability of these materials for use in groundwater monitoring wells. Previous studies compared these materials for sorption of dilute organic solutes, leaching of organic constituents, and resistance to degradation by chemicals, especially organic solvents. This particular study focuses on sorption and leaching of metals, and shows that the fiberglass materials were more apt to leach metal contaminants than PVC, FEP, and PTFE. Leached concentrations, with one exception (Pb leaching from FRP), were below maximum allowable limits set by the US EPA for drinking water. With respect to sorption, none of the polymers sorbed the anions tested, but all of them sorbed the cations tested. FEP and PTFE were much less sorptive than the other materials. These results and those from previous studies can be used, along with other considerations, to select a casing material that is best suited for the intended monitoring application and conditions in the well.

SR 96-09

COMPARISON CRITERIA FOR ENVIRONMENTAL CHEMICAL ANALYSES OF SPLIT SAM-

PLES SENT TO DIFFERENT LABORATORIES: CORPS OF ENGINEERS ARCHIVED DATA.

Grant, C.L., Jenkins, T.F., Mudambi, A.R., May 1996, 31p., ADA-310 390, 8 refs.
50-5912

GROUND WATER, CHEMICAL ANALYSIS, ACCURACY, SOIL ANALYSIS, METALS, EXPLOSIVES

Data comparison criteria were developed for quality control (QC) and quality assurance (QA) chemical analyses obtained during environmental studies directed by the U.S. Army Corps of Engineers (USACE). Archived results for 124 sets of eight metals in soils, 69 sets of fourteen volatile organic compounds (VOCs) in soils, 163 sets of total petroleum hydrocarbons (TPH) in soils, 79 sets of six explosives in soils, and 153 sets of fourteen VOCs in groundwater were analyzed statistically. Concentration ratios (QC₁/QC₂ and QC/QA) were lognormally distributed and this was the model used for comparisons. For both metals in soils and VOCs in groundwater, duplicate QC results should yield ratios between 0.50-2.00; less than 4% of the archived results were outside these limits. For QC/QA ratios, the limits suggested are 0.40-2.50; only 10.2% of metals ratios in soils and 5.6% of the VOCs in groundwater exceeded these limits. Considering that both methods are multi-analyte, the authors find only 4.0% of the metals samples and 2.0% of the VOC samples had more than one offending ratio per sample. Application of these limits to recent analyses produced very similar results. For VOCs, TPH, and explosives in soils, temporary limits of 0.25-4.00 are suggested with the understanding that improvements leading to tightening should be energetically pursued.

MONOGRAPHS

M 90-02

MODELING THE TRANSPORT OF HEAVY METALS IN SOILS.

Selim, H.M., Amacher, M.C., Iskandar, I.K., Sep. 1990, 156p., ADA-229 290, Refs. p.94-99.

48-3493

METALS, MATHEMATICAL MODELS, ISOTHERMS, COMPUTER PROGRAMS, SOIL MECHANICS

This monograph has two objectives. The first is to present an overview of the retention of heavy metals in soils and of methods of modeling their mobility in the soil profile. Widely used heavy-metal-retention models are described, with emphasis on the retention mechanisms characterized by time-dependent (or kinetic) and non-linear-type reactions. Sorption properties based on quasi-equilibrium of the Freundlich-type retention for Co, Ni, Cu, Zn, Cd, Hg, V, Cr, Mo, B, Pb, P, As, S, and Se by a number of soil orders are given. The second objective is the development of four general-purpose models for describing the behavior of heavy metal retention and mobility in soils. The proposed models are referred to as MRM, MRTM, SOTS, and SOMIM. The classical convection-dispersion equation is invoked to describe the transport of dissolved chemicals present in the soil solution when steady water flow is encountered. The retention mechanisms considered for heavy metals include non-linear kinetic mechanisms of the concurrent and concurrent-consecutive retention processes, a second-order kinetic approach, diffusion or first-order mass transfer of the mobile-immobile (two-region) concept, and irreversible reaction of the first-order kinetic type. Computer codes and sample input/output runs from each of these models are given, and validations of the models based on selected studies are presented.

M 90-03

SNOW ROADS AND RUNWAYS.

Abele, G., Nov. 1990, 100p., ADA-231 490, Refs. p.88-98.

45-1971

SNOW COMPACTION, SNOW (CONSTRUCTION MATERIAL), ANALYSIS (MATHEMATICS), SNOW ROADS, RUNWAYS, SNOW STRENGTH, TRAFFICABILITY

This monograph presents a complete review of all successful techniques that have been used to construct and maintain snow roads, trails and aircraft landing strips. The snow properties that must be considered prior to the construction process are identified, and the kinds of apparatus available for the measure of the properties are reviewed and assessed. A discussion of construction techniques is presented, which includes the types of snow pavements, the classification of roads by use, the classification of surface and subsurface strength, the considerations impacting on site selection, the various kinds of equipment that have been developed to construct and maintain the roads, and the additives that have been used to construct high-strength roads. The design criteria that have been established are cited.

M 90-04

NATURAL CONVECTION HEAT TRANSFER IN WATER NEAR ITS DENSITY MAXIMUM.

Yen, Y.C., Dec. 1990, 92p., ADA-233 106, 42 refs. 45-2237

TEMPERATURE EFFECTS, HYDRODYNAMICS, DENSITY (MASS/VOLUME), ICE WATER INTERFACE, HEAT TRANSFER, PHASE TRANSFORMATIONS, CONVECTION, WATER, ANALYSIS (MATHEMATICS)

This monograph reviews and summarizes to date the experimental and analytical results on the effect of water density near its maximum on convection, transient flow and temperature structure characteristics: 1) in a vertical enclosure; 2) in a vertical annulus; 3) between horizontal concentric cylinders; 4) in a square enclosure; 5) in a rectangular enclosure; 6) in a horizontal layer; 7) in a circular confined melt layer; and 8) in bulk water during melting. In a layer of water containing a maximum density temperature of 4°C, the onset of convection (the critical number) is not a constant value as in the classical normal fluid but one that varies with the imposed thermal and hydrodynamic boundaries. In horizontal layers, a nearly constant temperature zone forms and continuously expands between the warm and cold boundaries. A minimum heat transfer exists in most of the geometries studied and, in most cases, can be expressed in terms of a density distribution parameter. The effect of this parameter on the formation, disappearance, and transient structure of a cell is discussed, and the effect of split-boundary flow on heat transfer is presented.

M 91-01

PHYSICAL AND DYNAMIC PROPERTIES OF SEA ICE IN THE POLAR OCEANS.

Gow, A.J., Tucker, W.B., Sep. 1991, 46p., ADA-256 303, Refs. p.42-46.

47-704

ICE GROWTH, SEA ICE, ICE STRUCTURE, SEA ICE DIS-

TRIBUTION, ICE SALINITY, AIR WATER INTERACTIONS, OCEAN CURRENTS, ICE DENSITY, ICE COVER THICKNESS, SURFACE ROUGHNESS, ANTARCTICA—WEDDELL SEA, ANTARCTICA—MCMURDO SOUND, FRAM STRAIT, USSR—KARA SEA, UNITED STATES—ALASKA—KOTZEBUE SOUND

This monograph provides a current review of the state of knowledge of the growth, properties, and small- and large-scale behavior of sea ice found in the polar oceans of the northern and southern hemispheres. A major focus of the report is to contrast and compare the physical and dynamic properties of ice found in the Arctic seas with those found in the seas surrounding the antarctic continent. Very significant differences in the physical and dynamic properties of the ice are shown to exist that derive directly from differences in land-sea relationships between the two polar regions and their effect on ocean-atmosphere interaction and oceanic circulation. The same factors also determine, to a large degree, major differences in the seasonal distribution and extent of sea ice in the arctic and antarctic oceans. (Auth.)

M 92-01

EUROPEAN FOUNDATION DESIGNS FOR SEASONALLY FROZEN GROUND.

Farouki, O.T., Mar. 1992, 113p., ADA-250 833, 51 refs.

46-4001

FROST HEAVE, FOUNDATIONS, DESIGN, FROZEN GROUND MECHANICS, COLD WEATHER CONSTRUCTION

The report deals with the design of foundations against frost action in Europe, particularly as practiced in the Nordic countries. It describes how insulation is used in association with foundations of structures as part of a process of thermal engineering to produce safe and economic designs for various structures. The use of insulation enables heat management that allows shallower foundation depths and prevents damage from frost action. Results are given from the Norwegian Frost I Jord research project and the work at Lund University, Sweden, both of which provided the basis for the design guidelines of Norway, Sweden and Finland. Detailed slab-on-grade designs ensure that frost heave does not occur. Consideration is given to the design of foundations with a crawl space or basement, with their problems of sidegrip and horizontal frost pressure. Frost protection for unheated buildings is described, usually involving the use of insulation and drainage layers below the foundation with ground insulation nearby to retain soil heat. Designs with open foundations are described, as well as foundations for retaining walls and bridges. Frost protection required during winter construction is detailed.

M 92-02

REVIEW OF THE PROCESSES THAT CONTROL SNOW FRICTION.

Colbeck, S.C., Apr. 1992, 40p., ADA-252 362, Refs. p.37-40.

46-4366

ANALYSIS (MATHEMATICS), TEMPERATURE EFFECTS, SURFACE ROUGHNESS, SNOW PHYSICS, PLASTICS SNOW FRICTION, POLYMERS, SLIDING, MELTWATER, SKIS, LUBRICANTS

There is a long history of interest in snow friction, but it is necessary to speculate about the details of the processes. Roughness elements and contact areas must be characterized before the basic processes can be well understood. These parameters change with movement over snow and, in fresh snow, probably change along the length of the slider. Friction results from a mixture of processes: dry, lubricated, and possibly capillary. Dry rubbing occurs at low speeds, loads, and/or temperatures and is characterized by solid-to-solid interactions requiring solid deformation. With small quantities of meltwater present, the contact area increases and there may be capillary attachments. Static charging probably occurs and may attract dirt that, even in the size range of micrometers, could complicate the processes. Slider thermal conductivity and even color are very important. Heat is generated by friction and solar radiation absorption but some is conducted away by the slider and ice particles. The remaining heat is available to generate meltwater, which acts as a lubricant. Polyethylene bases offer many advantages including low ice adhesion, high hydrophobicity, high hardness and elasticity, good machinability, and good absorption of waxes. While sliders must be designed for use over a narrow range of snow and weather conditions, polyethylene bases can be structured and waxed to broaden that range. The important processes operate not at the air temperature, but at the ski base temperature, which is highly dependent on such things as snow surface temperature, load, and speed.

M 93-02

GLACIOHYDROLOGIC AND GLACIOHYDRAULIC EFFECTS ON RUNOFF AND SEDIMENT YIELD IN GLACIERIZED BASINS.

Lawson, D.E., Nov. 1993, 108p., ADA-275 134,

Refs. p.92-108.

48-2538

GLACIAL HYDROLOGY, GLACIERS, RUNOFF, SEDIMENT TRANSPORT, MATHEMATICAL MODELS, GLACIER MASS BALANCE

Glaciers exert significant control on runoff and sediment yield of partly glacierized basins, such basins being inherently more complex than non-glacierized basins. Glaciohydraulic and glaciohydrologic processes and factors determine the characteristics of runoff and of sediment discharge of rivers draining glacierized catchments. Significant problems develop in predicting both short- and long-term variations in water and sediment discharge because of the complicating effects of these processes and factors. Predictions are necessary for effective management of a basin or watershed's water resources. These processes and factors must therefore be incorporated to improve predictive models of runoff and develop models for sediment yield. In this monograph, the current state of knowledge on the nature of runoff and sediment yield in rivers originating in partly glacierized basins is reviewed and integrated, in particular analyzing the glaciohydrologic and glaciohydraulic processes and factors determining basin characteristics. Current statistical and physical models for predicting runoff and sediment yield in glacierized basins are reviewed and, based upon an assessment of both the state of knowledge and modeling techniques, future research or application of existing knowledge to improve predictions is recommended.

TECHNICAL DIGESTS

TD 246(TR 246)

MOVEMENT OF MORTAR BASEPLATES ON SOIL; MORTAR STABILITY REPORT 1(U).

Aitken, G.W., Waterhouse, R.W., Dec. 1973, 110p., 12 refs.

48-3488

SOIL MECHANICS, MILITARY RESEARCH, MILITARY EQUIPMENT

This report presents the results to date of a continuing program to investigate the stability of mortars on soil foundations. The program is being conducted for USAWECOM (now part of USARMCOM) under the direction of Watervliet Arsenal. The primary objectives of the program are to characterize mortar stability, develop methods to predict stability, and provide design criteria for new mortars. To accomplish these objectives, a testing program was conducted using present and prototype mortars on controlled foundation soils. Disintegrating water projectiles were fired in this testing program. They produce a load-time response similar to those of actual projectiles at a lower cost and without the need for extensive range facilities. Mortar stability was quantified primarily in terms of baseplate displacement and the elevation throwoff of the mortar tube resulting from this displacement. The results show that baseplates follow a discrete trajectory through the soil, determined primarily by tube elevation. Load level is the main parameter dictating how far the baseplate moves along a particular trajectory. For a given trajectory and displacement there is a particular mount configuration that will provide minimum elevation throwoff of the mortar tube. The effects of baseplate spade depth and configuration were also investigated. It is shown that baseplate displacement is dependent upon spade orientation when firing at low tube elevations on sand, and that a baseplate with three spades displaces less than one with four under these conditions. Finally, a nondimensional parametric relationship for calculating baseplate displacement is developed. This relationship is based on fundamental steady-state elastic relationships.

TD 90-01

LUBRICANTS AT LOW TEMPERATURES.

Diemand, D., Dec. 1990, 24p., ADA-234 536, 21 refs.

45-2487

TEMPERATURE EFFECTS, LUBRICANTS, LOW TEMPERATURE TESTS, COLD WEATHER PERFORMANCE

TD 91-01

FRAZIL ICE BLOCKAGE OF INTAKE TRASH RACKS.

Daly, S.F., Mar. 1991, 12p., ADA-235 724, 14 refs. 45-2921

FRAZIL ICE, WATER INTAKES, ICE CONTROL

TD 91-02

AUTOMOTIVE FUELS AT LOW TEMPERATURES.

Diemand, D., Mar. 1991, 25p., ADA-236 040, 21 refs.

45-2920

FUELS, MOTOR VEHICLES, COLD WEATHER PERFORMANCE

TD 91-03

AUTOMOTIVE AND CONSTRUCTION EQUIPMENT FOR ARCTIC USE; HEATING AND COLD STARTING.

Diemand, D., Apr. 1991, 28p., ADA-236 039, 17 refs. 45-2919

COLD WEATHER PERFORMANCE, MOTOR VEHICLES, ENGINES, HEATING, ENGINE STARTERS

TD 91-04

AUTOMOTIVE BATTERIES AT LOW TEMPERATURES.

Diemand, D., May 1991, 23p., ADA-239 115, 12 refs. 46-45

MOTOR VEHICLES, ELECTRIC EQUIPMENT, ELECTRIC POWER, COLD WEATHER PERFORMANCE, LOW TEMPERATURE RESEARCH, DESIGN CRITERIA, WINTER MAINTENANCE, BATTERIES

Twelve-volt lead-acid batteries are almost universally used for electrical storage in automotive and construction vehicles in all areas. However, their performance depends strongly on temperature. This digest deals primarily with the performance of this type of battery at low operating temperatures.

TD 91-05

AUTOMOTIVE AND CONSTRUCTION EQUIPMENT FOR ARCTIC USE; MATERIALS AND PROBLEMS.

Diemand, D., Nov. 1991, 23p., ADA-244 835, 16 refs.

46-2568

BRITTLENESS, CRACKING (FRACTURING), CONSTRUCTION EQUIPMENT, COLD WEATHER OPERATION, COLD WEATHER PERFORMANCE, COLD WEATHER CONSTRUCTION, MOTOR VEHICLES, TEMPERATURE EFFECTS, METALS, PLASTICS

The objective of this digest is to provide a discussion of the general types of problems that will be encountered in automotive and construction equipment when used in the extreme cold and to provide guidelines for overcoming them. The properties and problems of metals are discussed first, followed by a discussion of plastics and elastomers.

TD 94-01

CLEARING ICE FOR BRIDGING OPERATIONS.

Diemand, D., Mar. 1994, 21p., ADA-280 227, 16 refs.

48-5425

ICE BREAKING, RIVER ICE, BRIDGES, PONTOON BRIDGES, ICE REMOVAL

The choice of a suitable method for breaking up an ice cover depends on the tactical situation, environmental conditions (ice thickness, current strength, shore conditions, etc.) and equipment at hand. The use of explosives will probably be faster than using chain saws, but the ice clearing operation will be longer.

TD 96-1

DESIGN OF ICE BOOMS.

Foltyn, E.P., Tuthill, A.M., Apr. 1996, 31p., ADA-310 197, 9 refs.

50-6068

ICE BOOMS, LAKE ICE, FLOATING ICE, ICE CONTROL, DESIGN, DESIGN CRITERIA, ANCHORS, JOINTS (JUNCTIONS), ICE SOLID INTERFACE, PHYSICAL PROPERTIES, STRUCTURAL ANALYSIS

This technical digest provides basic engineering design guidance for floating ice retention structures or ice booms. Basic types of booms and their ice control objectives are described briefly. The basic theory and equations used in ice boom design are then presented and typical structural components described. The report addresses other design considerations such as boom layout, geometry, and anchor systems, as well as the selection of wire rope and connection systems, and concludes with an example of ice boom design at a site. This technical digest describes the actual design steps in greater detail, and elaborates on boom geometry and the forces acting on ice boom components.

MISCELLANEOUS PUBLICATIONS

MP 2767

SURFACE ENERGY BALANCE AND SURFACE TEMPERATURE IN COLD REGIONS.

Lunardini, V.J., Ibrahim, H., International Conference on Development and Commercial Utilization of Technologies in Polar Regions, Copenhagen, Denmark, Aug. 14-16, 1990. Proceedings. Polartech '90, Hørsholm, Denmark, Danish Hydraulic Institute, 1990, p.101-110, 23 refs.

45-124

MATHEMATICAL MODELS, SEASONAL FREEZE THAW, SOIL FREEZING, GROUND THAWING, HEAT BALANCE, SURFACE TEMPERATURE, SOIL AIR INTERFACE, FROST PENETRATION, THAW DEPTH

The surface energy balance controls the surface temperature and hence the amount of energy exchanged between the cryosphere and the atmosphere. The temperature of the atmosphere is only one of the components of this energy balance and cannot, of itself, accurately describe the interaction between the atmosphere and soil masses in cold regions. A number of sites are available for which the seasonal values of the ground surface temperature and daily values of radiation and atmospheric conditions have been measured. The sites chosen for this study are particularly simple since the surfaces are paved and thus evapotranspiration need not be considered. Daily weather data were used to calculate radiation and sensible heat fluxes with standard equations. The calculated values agreed reasonably well with daily data for the sites and somewhat better for seasonal values. A simple phase change model for the ground mass allowed the seasonal (freeze or thaw) values of the ground surface temperature to be predicted; these predictions showed excellent agreement with measured quantities.

MP 2768

SEVERE FREEZING PERIODS AND THE FORMATION OF ICE JAMS AT SALMON, IDAHO.

Bilello, M.A., International Conference on Development and Commercial Utilization of Technologies in Polar Regions, Copenhagen, Denmark, Aug. 14-16, 1990. Proceedings. Polartech '90, Hørsholm, Denmark, Danish Hydraulic Institute, 1990, p.235-244, 3 refs.

45-137

RIVER ICE, AIR TEMPERATURE, DEGREE DAYS, ICE JAMS, FLOODS, METEOROLOGICAL FACTORS, UNITED STATES—IDAHO—SALMON RIVER

MP 2769

ELEMENTAL COMPOSITION, MORPHOLOGY AND CONCENTRATION OF PARTICLES IN FIRN AND ICE CORES FROM DYE-3, GREENLAND.

Kumai, M., Langway, C.C., Jr., *Bulletin of glacier research*, May 1990, No.8, p.1-18, 26 refs.

45-194

SCANNING ELECTRON MICROSCOPY, X RAY ANALYSIS, ICE CORES, FIRN, ICE COMPOSITION, IMPURITIES, GREENLAND

A variety of particles extracted from firn and ice core samples from DYE-3, Greenland, was investigated to characterize the type, nature and concentrations of material. A scanning electron microscope (SEM) and an energy dispersive X-ray (EDX) analyzer were employed to analyze particles in firn samples from three annual layers (1981-1983 A.D.) and ice core samples from depth of 833.412 m corresponding to 45 B.C. The particles were extracted by filtering the meltwater of each firn or ice sample with a nucleopore membrane filter having 0.4 micron pore diameter. In the firn samples (1981-1983 A.D.) relatively high concentrations of clay and silt particles were found, and low concentrations of quartz, pine pollen, spores and spherule particles. Some spherules were identified as coal fly ash by SEM and EDX analysis. In the deep ice core samples from 45 B.C., relatively high concentrations of clay and silt particles were found, and some pine pollen, spores and spherules. Some spherules are possibly of extraterrestrial origin. The mean concentration of particles in firn samples from 1981-1983 was 6.4 times higher than that of ice cores from 611 A.D., 45 B.C. and 730 B.C. The mean concentration of spherules in the firn was 27.3 times higher than that of the ice cores. The increase of spherules in the recent firn is mostly a result of deposition of coal fly ash spherules from modern industrial sources.

MP 2770

INTERPRETATION OF THE STRESS HISTORIES FROM SHOCK IMPACT TESTS ON SNOW USING EMBEDDED STRESS GAUGES.

Johnson, J.B., Brown, J.A., Gaffney, E.S., Shock

Compression of Condensed Matter-1989. Edited by S.C. Schmidt, J.N. Johnson and L.W. Davison, Elsevier Science Publishers, 1990, p.117-120, 6 refs.

45-400

SNOW LOADS, STRESSES, SNOW STRENGTH, IMPACT TESTS, SHOCK WAVES, MODELS

MP 2771

FROZEN GROUND EFFECTS ON INFILTRATION AND RUNOFF.

Kane, D.L., Chacho, E.F., Jr., Cold regions hydrology and hydraulics. Edited by W.L. Ryan and R.D. Crissman, New York, American Society of Civil Engineers, 1990, p.259-300, Refs. p.293-300.

45-410

FROZEN GROUND MECHANICS, UNFROZEN WATER CONTENT, SOIL WATER MIGRATION, THERMAL REGIME, SEEPAGE, GROUND WATER, SNOWMELT, FROZEN GROUND PHYSICS, HYDROLOGY, HYDROLOGIC CYCLE

Frozen soils in cold regions play a very dominant role in hydrologic processes. Both seasonal frost and permafrost can significantly reduce both infiltration into and migration through soils; at the same time, the amount of water that can be stored in the soil is severely reduced when permafrost exists. The behavior of frozen soils is most critical in determining the amount of groundwater recharged and the amount of runoff generated. Groundwater recharge from snowmelt in cold regions can be very important when the snowpack represents a large percentage of the annual precipitation. The moisture distribution within the frozen soil is the most significant factor in determining the hydrologic response of the soil. High moisture contents within the frozen soil can reduce the hydraulic conductivity of the soil by several orders of magnitude; such reductions will drastically influence both the volume and peak values of runoff. Most existing hydrologic models do not take into consideration the changes that occur in the hydraulic properties of seasonally frozen soils. Therefore, these models cannot be calibrated to accurately predict runoff when there are large variances in hydrologic properties.

MP 2772

VARIATIONS IN MECHANICAL PROPERTIES WITHIN A MULTI-YEAR ICE FLOE.

Tucker, W.B., Richter-Menge, J.A., Gow, A.J., Oceans '89 Conference, Seattle, Washington, Sep. 18-21, 1989. Proceedings, Volume 4, Institute of Electrical and Electronic Engineers, 1989, p.1287-1291, 15 refs.

45-446

ICE FLOES, POROSITY, SALINITY, SEA ICE, ICE COMPOSITION, MECHANICAL PROPERTIES, FLEXURAL STRENGTH

MP 2773

MONITORING RIVER ICE WITH LANDSAT IMAGES.

Gatto, L.W., *Remote sensing of environment*, 1990, Vol.32, p.1-16, 42 refs.

45-484

ICE FORECASTING, RESOLUTION, CLASSIFICATIONS, RIVER ICE, SPACEBORNE PHOTOGRAPHY, PHOTOINTERPRETATION, LANDSAT, ICE NAVIGATION

In the northern United States, ice can delay or stop river navigation in the winter and cause unexpected problems and emergencies. As part of a program to develop a river ice forecasting model, photointerpretation techniques were used to map the areal distributions of four classes of river ice along the navigable reaches of the Allegheny, Monongahela, and Ohio Rivers and the Illinois Waterway each winter from 1972 to 1985 from Landsat images. The four classes, 1) ice-free, 2) partial gray ice, 3) complete gray ice, and 4) white ice, were usually readily apparent on the images due to differences in gray tones produced by the various ice types and conditions that make up the different classes. Landsat-derived ice observations compared favorably with available ground and aerial observations 64-80% of the time. For many rivers in cold regions, Landsat images may be the only source of data on river ice.

MP 2774

FORECASTING SUPERSTRUCTURE ICING FOR NAVY COMBATANTS.

Ryerson, C.C., U.S. Navy Symposium on Arctic/Cold Weather Operations of Surface Ships, Nov. 29-Dec. 1, 1989. Proceedings. Volume 1, Washington, D.C., Dept of the Navy, [1989], p.287-296, 18 refs.

45-542

ICE ACCRETION, RESEARCH PROJECTS, SHIP ICING,

SUPERSTRUCTURES, ICE FORECASTING, ICE MODELS

A quasi-deterministic model of superstructure icing is being developed through CRREL at the University of Alberta for forecasting ice growth and load distribution on a Spruance-class cruiser. The model will compute spray cloud liquid water content and trajectory with ship heading and speed, sea state and weather, and will evaluate the spray droplet energy budget. Spray salinity, brine drainage, ship attitude, and superstructure shape are evaluated for their effects upon ice growth and distribution. Spray flux cannot be numerically evaluated with the current understanding of hydrodynamic processes, and thus the model relies upon empirically derived algorithms for water delivery on a Navy ship. This paper describes the model structure, progress of the model development, and its potential utility.

MP 2775

EFFECTIVENESS OF DEICING CHEMICALS IN REDUCING ICE ADHESION TO NONSKID SURFACES.

Lever, J.H., Rand, J.H., Gooch, G.E., U.S. Navy Symposium on Arctic/Cold Weather Operations of Surface Ships, Nov. 29-Dec. 1, 1989. Proceedings. Volume 1, Washington, D.C., Dept of the Navy, [1989], p.297-307, 12 refs.

45-543

SHIP ICING, AIRCRAFT LANDING AREAS, IMPACT TESTS, ICE ADHESION, ICE REMOVAL, SKID RESISTANCE, ICE ACCRETION

Through a series of laboratory tests, the effectiveness of 8 different deicing chemicals in reducing ice adhesion to the rough, non-skid surfaces used on aircraft carrier flight decks were examined. The test samples consisted of 18 in. x 18 in. coated steel plates, which were first sprayed with a light coating of liquid deicer which then accreted a uniform layer of freshwater glaze ice. To determine the shear adhesion strength, the iced samples were dropped onto a stiff spring, and the acceleration required to shed the ice was then measured. It was found that a relatively small amount of deicer, applied in advance of ice accretion, is extremely effective in reducing ice adhesion to non-skid surfaces. Such results suggest that advance application of deicing chemicals would significantly assist ice removal from carrier flight decks.

MP 2776

CONCURRENT REMOTE SENSING OF ARCTIC SEA ICE FROM SUBMARINE AND AIRCRAFT.

Wadhams, P., et al, Studies of sea ice thickness and characteristics from an arctic submarine cruise. Phase 3. Final report, Cambridge, England, SAIC Polar Oceans Associates, Feb. 20, 1990, 20p., ADA-219 391, Included as Appendix 1. 6 refs. For another version see 44-3376.

45-563

REMOTE SENSING, SUBGLACIAL OBSERVATIONS, AIRBORNE RADAR, SEA ICE, ICE BOTTOM SURFACE, ICE COVER THICKNESS, ICE SURFACE

MP 2777

TOP/BOTTOM MULTISENSOR REMOTE SENSING OF ARCTIC SEA ICE.

Comiso, J.C., Wadhams, P., Krabill, W.B., Swift, R.N., Crawford, J.P., Tucker, W.B., Studies of sea ice thickness and characteristics from an arctic submarine cruise. Phase 3. Final report, Cambridge, England, SAIC Polar Oceans Associates, Feb. 20, 1990, 56p., ADA-219 391, Included as Appendix 2. 27 refs.

45-564

REMOTE SENSING, SUBGLACIAL OBSERVATIONS, AIRBORNE RADAR, SEA ICE, ICE BOTTOM SURFACE, ICE COVER THICKNESS, ICE SURFACE

MP 2778

GEOPHYSICS IN THE STUDY OF PERMAFROST.

Scott, W.J., Sellmann, P.V., Hunter, J.A., Geotechnical and environmental geophysics. Volume 1. Review and tutorial. Edited by S.H. Ward, Tulsa, Society of Exploration Geophysicists, 1990, p.355-384, Refs. p.376-384. For earlier version see 34-1682.

45-668

EXPLORATION, GEOCRYOLOGY, ACOUSTIC MEASUREMENT, SEISMIC SURVEYS, RADAR ECHOES, PERMA-

FROST STRUCTURE, PERMAFROST DISTRIBUTION, PERMAFROST THERMAL PROPERTIES, PERMAFROST PHYSICS, PERMAFROST DEPTH, GEOPHYSICAL SURVEYS

MP 2779

INFLUENCE OF SHAPE ON ICEBERG WAVE-INDUCED VELOCITY STATISTICS.

Lever, J.H., Sen, D., Attwood, D., *Journal of offshore mechanics and arctic engineering*, Aug. 1990, Vol.112, p.263-269, 12 refs. For another version see 42-2093.

45-716

SIMULATION, OFFSHORE STRUCTURES, MECHANICAL TESTS, ICEBERGS, DRIFT, VELOCITY MEASUREMENT, PHYSICAL PROPERTIES, WATER WAVES, IMPACT

MP 2780

APPROXIMATE THERMODYNAMICS OF THE LIQUID-LIKE LAYER ON AN ICE SPHERE BASED ON AN INTERPRETATION OF THE WETTING PARAMETER.

Takagi, S., *Journal of colloid and interface science*, July 1990, 137(2), p.446-455, 17 refs.

45-795

WATER FILMS, THERMODYNAMIC PROPERTIES, ANALYSIS (MATHEMATICS), ICE VAPOR INTERFACE, ICE SURFACE, WETTABILITY, ICE WATER INTERFACE, ICE PHYSICS

The approximate thermodynamics of a liquid-like layer, which was originally developed for a planar ice surface based on an interpretation of the wetting parameter, is extended to a spherical ice surface to help discover the effects of the liquid-like layer on the properties of an ice surface.

MP 2781

PATH-AVERAGED TURBULENT HEAT FLUXES FROM SCINTILLATION MEASUREMENTS AT TWO WAVELENGTHS.

Andreas, E.L., *Society of Photo-Optical Instrumentation Engineers. Proceedings*, Apr. 1990, Vol.1312, p.93-105, 26 refs.

45-804

ANALYSIS (MATHEMATICS), SCINTILLATION, HEAT FLUX, TURBULENT FLOW

Measuring the scintillation of two electromagnetic waves that have propagated over a horizontal path near the earth's surface is tantamount to measuring the turbulent surface fluxes of sensible and latent heat, if the wavelengths were chosen correctly. The author calls this the two-wavelength method, and shows how to choose the two wavelengths and how to find the heat fluxes from a scintillation variable, the refractive index structure parameter. We optimize the two-wavelength method by pairing a short wavelength—one in the visible or infrared regions—with a long wavelength—one in the millimeter or radio regions. With such a two-wavelength combination, sensible heat and latent heat will, typically, have uncertainties of 10-20% when the Bowen ratio, $Bo =$ sensible heat divided by latent heat, obeys $-2.5 < Bo < 0.015$ or $0.03 < Bo < 5$.

MP 2782

SEA-ICE THICKNESS MEASUREMENT USING A SMALL AIRBORNE ELECTROMAGNETIC SOUNDING SYSTEM.

Kovacs, A., Holladay, J.S., *Geophysics*, Oct. 1990, 55(10), p.1327-1337, 21 refs.

45-837

DRIFT, SEA ICE, ICE ACOUSTICS, ELECTROMAGNETIC PROSPECTING, ICE COVER THICKNESS, ACOUSTIC MEASUREMENT, AIRBORNE EQUIPMENT

The evaluation of a small electromagnetic induction sounding system for use in airborne measurement of sea-ice thickness is discussed, as are the results from arctic field testing. Also outlined are the system noise and drift problems encountered during arctic field evaluation, problems which adversely affected the quality of the sounding data. The sea-ice sounding results indicate that for ice floes with moderate relief it should be possible to determine thickness to within 5 percent, but that because of sounding footprint size and current model algorithm constraints, steep-sided pressure ridge keels cannot be well defined. The findings also indicate that with further system improvement the day of routine sea-ice thickness profiling from an airborne platform is close at hand.

MP 2783

INFLUENCE OF ENVIRONMENTAL CONDITIONS ON ACOUSTICAL PROPERTIES OF SEA ICE.

Jezek, K.C., Stanton, T.K., Gow, A.J., Lange, M.A., *Journal of the Acoustical Society of America*, Oct. 1990, 88(4), p.1903-1912, 13 refs.

45-838

ICE COVER THICKNESS, SEA ICE, ICE ACOUSTICS

Sonar echo amplitude data have been collected at carrier frequencies of 188 and 120 kHz from the underside of different sea ice

types. Histograms of normal incidence echo amplitudes were formed from over 90 samples of each ice type. Experiments were conducted on saline ice grown in an outdoor pond under relatively controlled conditions at the USA Cold Regions Research and Engineering Laboratory (CRREL), and on the sea ice cover in the Fram Strait. Analysis shows marked variations (about a factor of 5) in the magnitude of the coherent reflection coefficients as congelation ice at the bottom of an ice sheet evolves from a growing dendritic interface to an ablating, thermally altered interface. Larger differences (about a factor of 10) are observed between growing congelation ice and slush ice, used to simulate frazil. These results indicate that important variations in acoustic regime exist in areas where different ice types are intermingled.

MP 2784

LIQUID CHROMATOGRAPHIC METHOD FOR DETERMINATION OF EXPLOSIVES RESIDUES IN SOIL: COLLABORATIVE STUDY.

Bauer, C.F., Koza, S.M., Jenkins, T.F., *Journal of the Association of Official Analytical Chemists*, 1990, 73(4), p.541-552, 13 refs.

45-839

STATISTICAL ANALYSIS, EXPLOSIVES, SOIL POLLUTION

A collaborative study of a sonic extraction/liquid chromatographic method for determining nitroaromatic and nitramine explosives in soil was conducted at 8 participating laboratories. Analytes HMX, RDX, TNB, DNB, tetryl, TNT, and 2,4-DNT were measured in duplicate for 4 field-contaminated soils and 4 spiked standard-matrix soils. Concentrations ranged from detection limits of about 1 microgram/g to nearly 1000 micrograms/g. Results were evaluated with and without data identified as outliers, which were often caused by electronic integrator miscalculation of chromatographic peak response. When outliers are excluded, method repeatability (within-laboratory relative standard deviation) for all analytes except tetryl is less than 5% for spiked soils and less than 18% for field-contaminated soils. Relative standard deviation generally decreases as analyte concentration increases. Reproducibility (between-laboratory relative standard deviation), except for tetryl and DNT, is less than 7% for spiked soils and 26% for field-contaminated soils. Thus, collaborators have nearly equivalent performance on spiked samples. For field-contaminated soils, some additional imprecision seems to result from the variability of extraction recoveries. Analyte recoveries from spiked soils are 95-97% for HMX, RDX, TNT, and DNT (similar to recoveries from aqueous samples); 92-93% for DNB and TNB; and 70% for tetryl. Poor results for tetryl (due to thermal degradation) are correctable if sonic bath temperatures are maintained near ambient. The method has been approved interim official first action by AOAC.

MP 2785

REFLECTION CRACKING STUDIES AT THULE AIR BASE, GREENLAND USING AC 2.5 AND FABRICS.

Eaton, R.A., Godfrey, R.N., *Association of Asphalt Paving Technologists Technical Sessions. Proceedings*, Feb. 1980, Vol.49, p.381-396, 7 refs.

45-995

BITUMINOUS CONCRETES, INTERFACES, RUNWAYS, CRACKING (FRACTURING), PAVEMENTS, COUNTERMEASURES, COLD WEATHER PERFORMANCE, GEOTEXTILES, GREENLAND—THULE AIR BASE

MP 2786

TWO-DIMENSIONAL NUMERICAL MODELING OF LARGE MOTIONS OF FLOATING BODIES IN WAVES.

Sen, D., Pawlowski, J.S., Lever, J.H., Hinchey, M.J., *International Conference on Numerical Ship Hydrodynamics*, 5th, Hiroshima, Japan, Sep. 25-29, 1989. Pt. I, 1989, p.257-277, 42 refs.

45-967

VISCOSITY, FLOATING STRUCTURES, SHIPS, HYDRODYNAMICS, WAVE PROPAGATION, WATER WAVES, COMPUTERIZED SIMULATION

A numerical method is described which simulates in the time domain the propagation of steep two dimensional periodic waves and the large motions induced by the waves on free floating bodies. The method allows for mild transient phenomena. In addition to several numerical results, computations of the sway forces and the roll and heave motions induced by steep periodic waves on a floating body restrained in the sway mode are presented and compared with the results of specially conducted model tests.

MP 2787

DETERMINATION OF THE FLUID-ELASTIC STABILITY THRESHOLD IN THE PRESENCE OF TURBULENCE: A THEORETICAL STUDY.

Lever, J.H., Rzentkowski, G., *Journal of pressure vessel technology*, Nov. 1989, Vol.111, p.407-419, 27 refs.

45-968

FATIGUE (MATERIALS), VIBRATION, HEAT TRANSFER, ELASTIC PROPERTIES, FLUID FLOW, TURBULENT

MISCELLANEOUS PUBLICATIONS

FLOW, PIPES (TUBES), STABILITY

A model has been developed to examine the effect of the superposition of turbulent buffeting and fluid-elastic excitation on the response of a single flexible tube in an array exposed to cross-flow. Turbulence is shown to have a significant effect on the determination of the stability threshold for the array. Different stability criteria are compared, and an attempt is made to provide some guidance in the interpretation of response curves from actual tests.

MP 2788

MODEL STUDY OF THE WAVE-DRIVEN IMPACT OF BERGY BITS WITH A SEMI-SUBMERSIBLE PLATFORM.

Lever, J.H., Colbourne, D.B., Mak, L.M., *Journal of offshore mechanics and arctic engineering*, Nov. 1990, Vol.112, p.313-322, 21 refs. For another version see 43-2650.

45-998

OCEAN WAVES, HYDRAULIC STRUCTURES, ANALYSIS (MATHEMATICS), ICEBERGS, ICE LOADS, OFFSHORE STRUCTURES, IMPACT TESTS

This paper describes model bergy bit/semi-submersible impact tests conducted in the 58 m wave tank at Memorial University. The objective of the tests was to develop a method to accumulate statistics on the locations and velocities of wave-driven iceberg/structure impacts. A single irregular sea state was used and 30 trials were conducted in each test series to accumulate the desired statistics. During each run, a camera system tracked the motions of both the bergy bit and the semi-submersible. This data and the geometry of both bodies was transferred to a CAD (computer-aided design) facility, which then recreated each test by redrawing the positions of the two bodies at each time step. In this manner, the impact locations and times without the obstruction of the water surface were determined, and the desired impact velocities and kinetic energies were computed. This paper describes the test and analysis techniques, and presents results for one test series. It also describes a new method to estimate impact kinetic energies using only open-water velocity data.

MP 2789

EVOLUTION OF SEA ICE OPTICAL PROPERTIES DURING FALL FREEZE-UP.

Perovich, D.K., *Society of Photo-Optical Instrumentation Engineers. Proceedings*, 1990, Vol.1302, Ocean optics 10, p.520-531, 16 refs.

45-850

ALBEDO, FREEZEUP, SNOW COVER EFFECT, SEA ICE, ICE OPTICS, SEA WATER FREEZING, LIGHT TRANSMISSION

During the seasonal transition from summer to winter conditions a profound transformation occurs in a sea ice cover. As air temperatures drop, the ice cools causing a reduction in the brine volume, melt ponds freeze, new ice forms in areas of open water, and the surface becomes snow-covered. There is a corresponding evolution in the optical properties of the ice cover with albedos increasing and transmittances decreasing. As part of the drift phase of the Coordinated Eastern Arctic Experiment (CEAREX), spectral albedos and reflectances in the visible and near-infrared (400-1100 nm) were measured during fall freeze-up. Observed albedos are presented for first-year ice, multiyear ice, and new-ice cases. In general, albedos increased as freeze-up progressed, with the increase being most pronounced at shorter wavelengths. There was a sharp increase in albedo associated with the surface becoming snow-covered. The greatest temporal changes occurred in a freezing lead where albedo increased from 0.1 for open water to 0.9 for snow-covered young ice in only a few days. The evolution of the transmitted radiation field under the ice was estimated using a simple two-stream radiative transfer model in conjunction with observations of ice morphology and thickness. Light transmission decreased dramatically due to ice cooling, snowfall, and declining incident solar irradiances.

MP 2790

SOLAR HEATING OF A STRATIFIED OCEAN IN THE PRESENCE OF A STATIC ICE COVER.

Perovich, D.K., Maykut, G.A., *Journal of geophysical research*, Oct. 15, 1990, 95(C10), p.18,233-18,245, 32 refs.

45-1020

ICE WATER INTERFACE, ICE COVER EFFECT, SOLAR RADIATION, SEA ICE, SEA WATER, RADIATION ABSORPTION, MELTWATER, WATER TEMPERATURE, CANADA—NORTHWEST TERRITORIES—MOULD BAY

MP 2791

ANATOMY OF A FREEZING LEAD.

Gow, A.J., Meese, D.A., Perovich, D.K., Tucker, W.B., *Journal of geophysical research*, Oct. 15, 1990, 95(C10), p.18,221-18,232, 19 refs.

45-1021

ICE COVER THICKNESS, ICE AIR INTERFACE, HEAT LOSS, SEA WATER FREEZING, ICE GROWTH, FREEZEUP, ICE STRUCTURE, ICE COMPOSITION, ICE SAMPLING

MP 2792 FREEZING OF WATER AND WASTEWATER SLUDGES.

Vesilind, P.A., Martel, C.J., *Journal of environmental engineering*, Sep.-Oct. 1990, 116(5), p.854-862, 20 refs.

45-1086

ICE CRYSTAL GROWTH, HYGROSCOPIC WATER, COLLOIDS, SLUDGES, FREEZING, WASTE TREATMENT, FREEZE THAW CYCLES, FREEZING RATE

MP 2793 METHOD FOR PREDICTING FREEZING IN FORCED FLOW.

Albert, M.R., Olfe, D.B., Fundamentals of phase change: freezing, melting, and sublimation. Edited by Y. Bayazitoglu and P.G. Kroeger, New York, American Society of Mechanical Engineers, 1990, p.9-14, 15 refs.

45-1163

MATHEMATICAL MODELS, ICE GROWTH, LAMINAR FLOW, FREEZING, ICE PHYSICS, ICE FORECASTING, PHASE TRANSFORMATIONS, ICE FORMATION
A numerical method for calculating freezing in forced laminar flow with the possibility of recirculation in the flow is presented. The method is applied to problems involving smooth and stepped ice interfaces for flow between parallel plates.

MP 2794 INTERNATIONAL CLASSIFICATION FOR SEA- SONAL SNOW ON THE GROUND.

Colbeck, S.C., et al, International Association of Scientific Hydrology. International Commission on Snow and Ice. Working Group on Snow Classification, International Association of Scientific Hydrology, [1990], 23p.

45-1174

SNOW CRYSTAL STRUCTURE, SNOW COVER STRUCTURE, MEASUREMENT, SNOW COVER, SNOW MORPHOLOGY, PHYSICAL PROPERTIES, CLASSIFICATIONS

MP 2795 ATMOSPHERIC ICING WITH ELEVATION ON NEW ENGLAND MOUNTAINS.

Ryerson, C.C., International Conference on Atmospheric Icing of Structures, 4th, Paris, Sep. 5-7, 1988, 1988, p.89-93, 11 refs.

45-1318

MOUNTAINS, ICING RATE, WIND FACTORS, ICING, ICE ACCRETION, ALTITUDE

Variations in atmospheric icing conditions with elevation on three New England mountains were analyzed statistically. Icing was monitored along a west-facing vertical transect of 1100-m Madonna Peak in the Green Mountains, and at the summits of New Hampshire's 1917-m Mount Washington and Vermont's 1339-m Mount Mansfield. Icing rarely occurs below 800 m, and increases approximately exponentially to the summit elevation of Mount Washington. Ice accretion along slopes near the ground surface correlates with relief exposure, with even slight promontories accumulating more ice than hollows. At the summits, icing occurs about three times as often on Mount Washington as on Mount Mansfield, and mean monthly icing rates are about 50 times greater on Mount Washington.

MP 2796 DENSITY OF NATURAL ICE ACCRETIONS.

Jones, K.F., International Conference on Atmospheric Icing of Structures, 4th, Paris, Sep. 5-7, 1988, 1988, p.114-118, 12 refs.

45-1323

METEOROLOGICAL FACTORS, ANALYSIS (MATHEMATICS), ICE FORECASTING, ICING, ICE ACCRETION, ICE DENSITY

The particular meteorological conditions under which atmospheric icing occurs determine the density of the accreted ice. Density information is required to calculate the accreted ice load on an object. A density formula developed by Macklin (1962) from artificially iced samples is often used to calculate rime ice density as a function of R (effective droplet diameter multiplied by droplet impact speed divided by icing surface temperature). In this study icing data collected in natural conditions at the summit of Mt. Washington in New Hampshire was used to test Macklin's relationship. The Mt. Washington Observatory has been making icing measurements using rotating multicylinders since 1969. Meteorological and icing data from these observations were used along with accretion weight and volume data from each of the six cylinders in the multicylinder set to relate ice accretion density to Macklin's R parameter. A least-squares fit for density as a function of R was obtained that indicates a different relationship from that obtained by Macklin. A multiple regression analysis was performed to relate the ice accretion density directly to air temperature, wind speed, cloud liquid water content, cloud median volume droplet diameter, and cylinder diameter.

MP 2797 ARCTIC RESEARCH IN THE UNITED STATES, VOL.4.

U.S. Interagency Arctic Research Policy Committee, Brown, J., ed, Bowen, S.L., ed, Cate, D.W., ed, Washington, D.C., Fall 1990, 106p.

45-1398

INTERNATIONAL COOPERATION, RESEARCH PROJECTS, MEETINGS, EXPEDITIONS, ORGANIZATIONS, POLAR REGIONS

MP 2802 WINTER SHORT-PULSE RADAR STUDIES ON THE TANANA RIVER, ALASKA.

Delaney, A.J., Arcone, S.A., Chacho, E.F., Jr., *Arctic*, Sep. 1990, 43(3), p.244-250, With French summary. 24 refs.

45-1421

FROST PENETRATION, DIELECTRIC PROPERTIES, WATER TABLE, RIVER ICE, SUBSURFACE INVESTIGATIONS, GROUND WATER, RADAR ECHOES, AERIAL SURVEYS, WATER SUPPLY, SUBGLACIAL OBSERVATIONS, UNITED STATES—ALASKA

MP 2803 INTEGRATING RADAR-RAINFALL DATA INTO THE HYDROLOGIC MODELING PRO- CESS.

Engdahl, T.L., McKim, H.L., Conference on Operational Precipitation Estimation and Prediction, Anaheim, CA, Feb. 7-8, 1990, Boston, MA, American Meteorological Society, 1990, p.69-73, 14 refs.

45-1430

RAIN, PRECIPITATION (METEOROLOGY), HYDROLOGIC CYCLE, COMPUTERIZED SIMULATION, RADAR

MP 2804 LIQUID CHROMATOGRAPHIC SEPARATION OF 2,4,6-TRINITROTOLUENE AND ITS PRIN- CIPAL REDUCTION PRODUCTS.

Walsh, M.E., Jenkins, T.F., *Analytica chimica acta*, 1990, Vol.231, p.313-315, 10 refs.

45-1431

EXPLOSIVES, MILITARY RESEARCH
A liquid chromatographic method is described for the baseline separation of 2,4,6-trinitrotoluene (TNT) and its main reduction products. Two analytical columns (LC-18 and LC-CN) are connected in series and eluted isocratically at 1.5 ml/min with water-methanol-tetrahydrofuran (60.5+25+14.5). The capacity factors (k') are 1.4, 1.6, 5.1, 6.4 and 7.0 for 2,6-diamino-4-nitrotoluene, 2,4-diamino-6-nitrotoluene, TNT, 4-amino-2,6-dinitrotoluene and 2-amino-4,6-dinitrotoluene, respectively.

MP 2805 MICROCOMPUTER SIMULATION OF PHASE CHANGE HEAT TRANSFER.

Farag, I.H., Buzzell, G.M., Phetteplace, G.E., *International journal of heat and technology*, 1990, 8(1-2), p.43-65, 22 refs.

45-1432

HEAT TRANSFER, PHASE TRANSFORMATIONS, COMPUTERIZED SIMULATION, LATENT HEAT, COOLING SYSTEMS, UNDERGROUND PIPELINES, MELTING, FREEZING

The development of a microcomputer-based finite element program with the ability to simulate phase change (melting and freezing) is outlined. A closed form Galerkin finite element method derived from a delta function formulation of the latent heat discontinuity in the heat capacity versus temperature function is used within phase change elements of the solution domain. Storage reduction data structures are implemented and compared on the basis of overall program execution time. Analytical solutions for melting and freezing are used to verify program accuracy and to explore other simulation parameters such as time step size, mesh density and start-up technique. Several "life like" phase change simulations are compared to the results obtained from other numerical models.

MP 2806 SEASONAL VARIATION OF SOME CONSTITU- ENTS OF ANTARCTIC TROPOSPHERIC AIR.

Hogan, A.W., Egan, W.G., Samson, J.A., Barnard, S.C., Riley, D.M., Murphy, B.B., *Geophysical research letters*, Dec. 1990, 17(12), p.2365-2368, 22 refs.

45-1514

METEOROLOGY, AIR MASSES, SEASONAL VARIATIONS, ATMOSPHERIC COMPOSITION, AEROSOLS, CARBON DIOXIDE, WATER VAPOR

The interior of Antarctica is dominated by the continental Antarctic [cA] air mass, which resides entirely on the antarctic ice, and only receives heat, moisture and particles by exchange with surrounding air masses. The concentrations of carbon dioxide, total aerosol, and soot aerosol do not vary coincidentally in this air

mass during antarctic spring. A hypothesis describing the modification of these properties within the cA air mass through exchange with the surrounding air masses and variation of the source strength of marine aerosol in maritime polar air masses is proposed. (Auth.)

MP 2807 O-18 CONCENTRATIONS IN SEA ICE OF THE WEDDELL SEA, ANTARCTICA.

Lange, M.A., Schlosser, P., Ackley, S.F., Wadhams, P., Dieckmann, G.S., *Journal of glaciology*, 1990, 36(124), p.315-323, 34 refs.

45-1542

ICE COVER THICKNESS, ICE FORMATION INDICATORS, SEA ICE DISTRIBUTION, SNOW ICE, OXYGEN ISOTOPES, ICE GROWTH, SNOW COVER EFFECT, ICE COMPOSITION, ANTARCTICA—WEDDELL SEA

Data are presented on ice texture, salinity, and $\delta^{18}\text{O}$ -18 obtained from identical sections of ice cores during the Winter Weddell Sea Project 1986 on RV *Polarstern* from July through Aug. 1986, in the longitude range between 5W and 7E. No uniquely definable relationship between $\delta^{18}\text{O}$ -18 values and ice texture in a particular section is found. However, most of the snow ice as well as some sections of frazil ice are found to have negative $\delta^{18}\text{O}$ -18 concentrations, due to varying degrees of admixtures of meteoric ice (snow) and sea-water during formation of snow ice. In contrast to common assumptions, these results seem to indicate that a snow cover contributes positively to sea-ice growth rather than slowing down the overall growth rate. Based on a simple model, the contributions of meteoric ice (mean of 3 +/- 3%) and the combined meteoric ice/sea-water fraction (a minimum of 7 +/- 6%) to the total ice thickness for the majority of the sampled floes are estimated. Although this is only a moderate contribution to the overall mass balance, in the absence of conglaciation growth it nevertheless enhances ice growth in general. This hypothesis is independently supported by snow- and ice-thickness data which demonstrate that the depression of the snow/ice interface below the water line (i.e. a negative freeboard) and the formation of snow ice is a common occurrence in the Weddell Sea. Therefore, it is hypothesized that the major part of the observed apparent increase in ice thickness between the inbound and outbound tracks of WWSP'86 may not be derived from "regular", thermodynamically driven conglaciation growth, but rather from the snow-ice component in floes of the Weddell Sea. (Auth. mod.)

MP 2808 THERMAL EXPANSION COEFFICIENTS FOR SEA ICE.

Johnson, J.B., Metzner, R.C., *Journal of glaciology*, 1990, 36(124), p.343-349, 26 refs.

45-1545

TEMPERATURE EFFECTS, ICE THERMAL PROPERTIES, SALINITY, SEA ICE, THERMAL EXPANSION, ICE VOLUME, ANALYSIS (MATHEMATICS), THERMAL ANALYSIS

Coefficients of thermal linear expansion were determined for sea ice using a Michelson interferometer. Over a temperature range of -4 to -15 C, the coefficients varied from .000045 to .000054/C for ice with a salinity of 2 ppt, and from .000033 to .000053/C for ice with a salinity of 4 ppt. Initially, warming the sea ice resulted in coefficients that were the same as those for fresh-water ice, within the limits of experimental error. Subsequent sea-ice cooling resulted in coefficients that were initially lower than those for fresh-water ice, but that asymptotically approached the coefficient values for fresh-water ice at colder temperatures. On the second warming and cooling cycle, the coefficients of thermal linear expansion exhibited hysteresis and a decrease in magnitudes. It is also shown that Pettersson's (1883) and Malmgren's (1927) measurements of the thermal volume expansion of sea ice were the result of phase transitions that caused brine expulsion, when air-free sea ice was cooled, and internal porosity increases, when sea ice was warmed. These results indicate that Pettersson's and Malmgren's measurements of the thermal volume expansion of sea ice are in error. Consequently, theoretical descriptions based on their results are incorrect. The results for the initial sea-ice warming cycle do agree with Cox's (1983) analysis.

MP 2809 VAPOR-PRESSURE DEPENDENCE ON TEM- PERATURE IN MODELS OF SNOW META- MORPHISM.

Colbeck, S.C., *Journal of glaciology*, 1990, 36(124), p.351-352, 14 refs.

45-1547

HEAT TRANSFER, METAMORPHISM (SNOW), VAPOR PRESSURE, TEMPERATURE EFFECTS, MATHEMATICAL MODELS

MP 2810 ON THE SYSTEMATIC VARIATION IN SUR- FACE AEROSOL CONCENTRATION AT THE SOUTH POLE.

Samson, J.A., Barnard, S.C., Obremski, J.S., Riley, D.C., Black, J.J., Hogan, A.W., *Atmospheric*

research, 1990, Vol.25, p.385-396, 34 refs.

45-1429

METEOROLOGY, METEOROLOGICAL INSTRUMENTS, METEOROLOGICAL CHARTS

Aerosol observations have been made at the Amundsen-Scott Station on a disciplined schedule since Jan. 1974. Analysis of the data shows a repeatable annual cycle in surface aerosol concentration characterized by a twenty-fold increase during the spring months as lower-latitude air is advected onto the Polar Plateau. During the nine-year period 1977-1985, the mean values of the aerosol concentrations for the spring months, as well as for the entire calendar year, decreased. The diminution of surface aerosol at the South Pole appears to be statistically significant.

MP 2811

MOISTURE IN MEMBRANE ROOFS.

Tobiasson, W., *Custom builder*, Aug. 1989, p.31-32, 37-38.

45-1581

ROOFS, MOISTURE, HUMIDITY, VAPOR BARRIERS, CONSTRUCTION MATERIALS

MP 2812

USING SCINTILLATION AT 2 WAVELENGTHS TO MEASURE PATH-AVERAGED HEAT FLUXES IN FREE CONVECTION.

Andreas, E.L., *Boundary-layer meteorology*, 1991, Vol.54, p.167-182, 37 refs.

45-1585

SCINTILLATION, BOUNDARY LAYER, HEAT FLUX, CONVECTION, MEASUREMENT, ANALYSIS (MATHEMATICS)

Local free convection scaling is one of the obvious triumphs of boundary-layer similarity theory. In free convection, there is no dynamic velocity scale; the sensible and latent heat fluxes, therefore, scale directly with the temperature and humidity structure parameters. By using scintillation to measure the refractive index structure parameter at two electromagnetic (EM) wavelengths, the temperature and humidity structure parameters can be obtained and thus in effect measure path-averaged values of the sensible and latent heat fluxes. Here the author describes this so-called two-wavelength method for free convection, derives quantitative guidelines for optimizing the method, and evaluates its potential accuracy. The author shows that the two-wavelength method works best when one EM wavelength is in the visible or infrared region and the other is in the millimeter or radio region. When the Bowen ratio is between -5 and -0.1 or between 0.1 and 5, the expected accuracy of the measured fluxes is +/- 10-20%—typical of what is possible with eddy-correlation measurements. With the two-wavelength method, however, the fluxes represent spatial averages.

MP 2813

SEISMIC STUDIES ON THE GRID EASTERN HALF OF THE ROSS ICE SHELF: RIGGS III AND RIGGS IV.

Albert, D.G., Bentley, C.R., *American Geophysical Union. Antarctic research series*, 1990, Vol.42, Ross Ice Shelf: glaciology and geophysics, p.87-108, Refs. p.107-108.

45-1611

ICE SHELVES, ICE COVER THICKNESS, SEISMIC SURVEYS, BOTTOM TOPOGRAPHY, ICE PHYSICS, SEISMIC REFRACTION, ANTARCTICA—ROSS ICE SHELF
Seismic P wave refraction experiments at three locations on the Ross Ice Shelf during 1976-1977 (RIGGS III) and 1977-1978 (RIGGS IV) reveal that the velocity increases monotonically in the firm from about 500 m/s at the surface to about 3800 m/s at a depth of 60 m. Maximum P wave velocities measured at 4 locations on the ice shelf show a large range of values primarily indicative of lateral inhomogeneities, but perhaps also resulting from anisotropy. Water depths for 89 additional stations were determined using seismic reflections from the ocean floor, together with ice thicknesses measured by radar and seismic techniques. Systematic differences that appear between ice thicknesses measured by the two techniques on RIGGS IV but not on RIGGS III most likely reflect an unrecognized systematic error in measurement. (Auth. mod.)

MP 2814

QUASI-STEADY PROBLEMS IN FREEZING SOILS: II. EXPERIMENT ON THE STEADY GROWTH OF AN ICE LAYER.

Takeda, K., Nakano, Y., *Cold regions science and technology*, Nov. 1990, 18(3), p.225-247, 14 refs.

45-1616

TEMPERATURE GRADIENTS, SOIL WATER MIGRATION, SOIL FREEZING, SOIL TESTS, ICE GROWTH, ICE LENSES, THERMAL CONDUCTIVITY

A series of freezing tests on three kinds of soil were conducted to find the steady growth condition of a segregated ice layer by using a new steady-state method in which the temperature profiles of soil specimens were controlled. It was found that the steady growth condition is determined by the absolute value of the temperature gradient of the unfrozen part of the soil $\alpha_{\text{unf}} \lambda$ and that of the frozen part of the soil $\alpha_{\text{f}} \lambda$ under a given hydraulic condi-

tion as follows $\alpha_{\text{unf}} \lambda = S \alpha_{\text{f}} \lambda$, $k_1 / k_0 > S > S_0$, $\alpha_{\text{f}} \lambda < A$, where k_1 and k_0 are the thermal conductivity of the frozen and the unfrozen parts, respectively, and S_0 and A constants that are the properties of a given soil. Comparing these experimental results with the results of the mathematical analysis presented in part I, it is found that the model M1 is consistent with the experimental results while the models M2 and M3 contradict them.

MP 2815

REVERSED DIRECT-STRESS TESTING OF ICE: EQUIPMENT AND EXAMPLE RESULTS.

Cole, D.M., Gould, L.D., *Cold regions science and technology*, Nov. 1990, 18(3), p.295-302, 11 refs.

45-1619

COMPRESSIVE PROPERTIES, TEST EQUIPMENT, MECHANICAL TESTS, ICE STRENGTH, DESIGN

This paper describes in detail a recently developed fixture for performing completely reversed (e.g., tension to compression) uniaxial stress experiments on ice. The device rigidly holds an ice specimen having bonded end caps without loading the specimen or inducing a bending moment. It is self aligning and hydraulically actuated. One of the important and unique features of the system is that it corrects for end-cap misalignment at the end cap rather than at some distance from it. The ideas underlying the design of the system are discussed. The results of a number of experiments are presented to demonstrate the capabilities of the device and to illustrate the types of mechanical property information that can be generated using this experimental technique.

MP 2816

REVERSED DIRECT-STRESS TESTING OF ICE: INITIAL EXPERIMENTAL RESULTS AND ANALYSIS.

Cole, D.M., *Cold regions science and technology*, Nov. 1990, 18(3), p.303-321, 35 refs.

45-1620

INTERNAL FRICTION, TEST EQUIPMENT, ICE STRENGTH, MECHANICAL TESTS, LOADING, DEFORMATION, ICE MICROSTRUCTURE

This paper focuses on the analysis and discussion of the results of a series of reversed direct-stress experiments performed on freshwater ice. A companion paper (Cole and Gould, this issue) describes the apparatus developed for these experiments. The experimental technique provides a means to subject cylindrical ice specimens to fully reversed (i.e., alternating tension/compression) uniaxial loading, thereby permitting the study of cyclic-loading effects under a uniform stress field. The topics include frequency, temperature and strain-amplitude effects on internal friction; cyclic loading-history effects on tensile strength, grain-size effects on cyclic stress-strain behavior and the Bauschinger effect. The observations are discussed in terms of the mechanisms underlying the behavior, with particular attention to dislocation processes. The observations indicate the operation of the dislocation breakaway process and the Granato-Lücke theory models the associated amplitude-dependent internal friction results extremely well.

MP 2817

RADON MEASUREMENTS AS INDICATORS OF PERMAFROST DISTRIBUTION.

Sellmann, P.V., Delaney, A.J., *Cold regions science and technology*, Nov. 1990, 18(3), p.331-336, 9 refs.

45-1622

VAPOR DIFFUSION, CORRELATION, PERMAFROST DISTRIBUTION, GASES, RADIOACTIVITY, MEASUREMENT, SUBSURFACE STRUCTURES, SOIL COMPOSITION

Observations in central Alaska indicate that radon concentrations in surface soils over discontinuous permafrost seem to correspond with frozen-ground distribution. These observations were made to determine if radon measurements might provide a method for obtaining information on permafrost distribution. Radon levels from an area of silty soils varied from 14 to 348 pCi/l and averaged 51 pCi/l where the top of permafrost was within a meter of the ground surface, compared to an average of 190 pCi/l where permafrost was absent.

MP 2818

FROST HEAVE FORCES ON H AND PIPE PILES EMBEDDED IN FAIRBANKS SILT.

Johnson, J.B., Buska, J.S., *Alaska. Department of Transportation and Public Facilities. Report*, May 1988, FHWA-AK-RD-88-02, 83p., 29 refs.

45-1649

SOIL TEMPERATURE, SHEAR STRESS, DESIGN CRITERIA, STRAIN TESTS, ICE SOLID INTERFACE, PILES, FROST HEAVE, PERMAFROST BENEATH STRUCTURES, FROZEN GROUND MECHANICS, LOADS (FORCES), ICE ADHESION

The magnitude and variation of forces and shear stresses, caused by frost heaving in Fairbanks silt and the adfreeze effects of a surface ice layer and a gravel layer, were determined using electric strain gauges as a function of depth along the upper 2.75 m of a pipe pile, 30.5 cm I.D. x 0.95 cm wall and an H pile, 25.4 cm web x 85 kg/lineal m, for three consecutive winter seasons (1982-1985). The peak frost heaving forces on the H pile during each winter were 752, 790 and 802 kN. Peak frost heaving forces on the pipe pile of 1118 and 1115 kN were determined only for the

second and third winter seasons. Maximum average shear stresses acting on the H pile were 256, 348 and 308 kPa during the three winter seasons. Maximum average shear stresses acting on the pipe pile were 627 and 972 kPa for the second and third winter seasons. Ice collars were placed around the tops of both piles during the first and third winter seasons to measure the adfreeze effects of a surface ice layer. A 0.6 m thick gravel layer replaced the soil around the tops of both piles for the second and third winter seasons to measure the adfreeze effects of a gravel backfill. The gravel layer on the H pile may have contributed about 35% of the peak forces measured. The important mechanisms that determine the magnitude of uplift heave forces are (1) soil heaving as the driving force, and (2) soil temperature, which controls the unfrozen water content, the mechanical properties of the soil and the area of influence of heaving pressures.

MP 2819

MODELLING SEA ICE THERMODYNAMICS AND DYNAMICS IN CLIMATE STUDIES.

Hibler, W.D., III, *NATO Advanced Study Institute on Physically-Based Modelling and Simulation of Climate and Climate Change, Part 1. Proceedings*, edited by M.E. Schlesinger, Dordrecht, Kluwer Academic Publishers, 1988, p.509-563, 47 refs.

45-1646

SEA ICE, THERMODYNAMIC PROPERTIES, ICE MECHANICS, ICE MODELS, CLIMATE

The presence of sea ice cover substantially modifies air-sea heat and momentum exchanges in the polar regions, and hence can play a major role in high-latitude climate sensitivity. Because of its mobility, the dynamics and thermodynamics of this ice cover are intrinsically related. The purely thermodynamic properties of sea ice are very dependent on the fact that it is an admixture of brine pockets and fresh water ice. This causes sea ice to have a greater equilibrium thickness than freshwater ice and to have a different seasonal cycle of thickness change. The dynamical features of sea ice are characterized by a highly nonlinear ice interaction that causes the ice pack to strongly resist compression while having a relatively weak resistance to dilation. The strength of the interaction is tied to the amount of thin ice which is created by the opening of leads and is removed by ice growth or pressure ridging. A plastic rheology offers a consistent means of modelling this highly nonlinear ice interaction. Results of several numerical simulations are discussed; these include the response of an antarctic sea ice model to atmospheric warming, and the behavior of a coupled ice-ocean model of the Arctic, Greenland and Norwegian seas. In the case of ice-ocean coupling it is shown that the ocean circulation is essential for realistic simulation of the ice margin in the Greenland and Norwegian seas. (Auth. mod.)

MP 2820

THREE-WAVELENGTH METHOD OF MEASURING PATH-AVERAGED TURBULENT HEAT FLUXES.

Andreas, E.L., *Journal of atmospheric and oceanic technology*, Dec. 1990, 7(6), p.801-814, 36 refs.

45-1665

LATENT HEAT, ANALYSIS (MATHEMATICS), REFRACTION, OPTICAL PROPERTIES, HEAT FLUX, AIR TEMPERATURE, HUMIDITY, TURBULENT FLOW

Conceptually, electro-optical measurements of the path-averaged refractive index structure parameter should yield measurements of the vertical fluxes of sensible and latent heat. With three independent measurements we can compute the meteorologically relevant temperature, humidity, and temperature-humidity structure parameters. The sensible and latent heat fluxes derive from these and a simultaneous electro-optical measurement of the path-averaged turbulent kinetic energy dissipation rate through inertial-dissipation calculations. A sensitivity analysis shows that at 0.94 micron, 10.6 microns, and 3.33 mm, the three-wavelength method would yield measurements of the temperature structure parameter accurate to +/- 20% when the Bowen ratio, the sensible heat flux divided by the latent heat flux, is in the range of 0.1 to 10. The measurement of the humidity structure parameter is potentially accurate to +/- 10% but only when the Bowen ratio is 0.01 to 0.5. Outside this range the accuracy is much worse. The measurement accuracy of the temperature-humidity structure parameter is poor. The predicted uncertainty is no better than +/- 40%. This three-wavelength combination, however, can yield the sign of the temperature-humidity structure parameter when the Bowen ratio is 0.015 to 0.5. If instead of the 10.6 micron wavelength we substitute a wavelength of 18.8 microns where laser measurements are more difficult, the Bowen ratio ranges over which we could measure both the humidity structure parameter and the sign of the temperature-humidity structure parameter expand. For the humidity structure parameter, the useful Bowen ratio range is now 0.01 to 1; and for the sign of the temperature-humidity structure parameter, it is roughly 0.02 to 2.

MP 2821

CONVERTING DIGITAL PASSIVE MICRO-WAVE RADIANCES TO KELVIN UNITS OF BRIGHTNESS TEMPERATURES.

Farmer, L.D., Eppler, D.T., Lohanick, A.W., *U.S. Naval Ocean Research and Development Activity. NORDA technical note*, Sep. 1990, No.427, 16p.,

ADA-228 407, 7 refs.

45-932

SEA ICE, BRIGHTNESS, RADIANCE, MICROWAVES, RADIOMETRY

MP 2822

KRMS GEOSAT-LIMEX '87 DATA PRODUCTS. Eppler, D.T., Farmer, L.D., *U.S. Naval Ocean Research and Development Activity. NORDA technical note*, July 1988, No.388, 42p., ADA-219 728, 4 refs.

45-561

DATA PROCESSING, COMPUTER PROGRAMS, ICE CONDITIONS, SEA ICE DISTRIBUTION, ICE EDGE, REMOTE SENSING, CANADA—LABRADOR SEA

MP 2823

INFLUENCE OF SHORT-TERM CLIMATE FLUCTUATIONS ON PERMAFROST TERRAIN. Brown, J., Andrews, J.T., *U.S. Department of Energy. Report*, May 1982, Carbon Dioxide Effects Research and Assessment Program. Environmental and Societal Consequences of a Possible CO₂-Induced Climate Change Vol.II, Part 3, 33p., DE82 017379, 50 refs.

45-1931

CLIMATIC CHANGES, PERMAFROST THERMAL PROPERTIES, CARBON DIOXIDE, GEOMORPHOLOGY, TERRAIN

MP 2824

CONTAMINATION OF AQUEOUS SAMPLES WITH FORMATE AND ACETATE FROM AMBIENT AIR.

Hewitt, A.D., Cragin, J.H., *Atmospheric environment*, 1991, 25A(2), p.453-457, 11 refs.

45-1697

WATER CHEMISTRY, MELT WATER, PRECIPITATION (METEOROLOGY), AIR POLLUTION, CHEMICAL ANALYSIS, SOLUTIONS, VAPOR DIFFUSION

A sensitive ion chromatographic technique with detection limits of 1.9 and 6.2 micrograms/l has been developed for the determination of formate and acetate ions, respectively, in aqueous solution. Using this technique, uncovered aqueous solutions have been found to absorb the corresponding acids readily from ambient air at rates of approximately 0.02-0.1 nm/sq cm/h. Consequently, to prevent vapor diffusion and subsequent contamination of environmental samples with these organic acids, casual exposure to ambient air, particularly in a laboratory, should be minimized.

MP 2825

ONE-DIMENSIONAL TEMPERATURE MODELING TECHNIQUES: REVIEW AND RECOMMENDATIONS.

Balick, L.K., Hummel, J.R., Smith, J.A., Kimes, D.S., *U.S. Army Cold Regions Research and Engineering Laboratory. Smart Weapons Operability Enhancement Program Office. Report*, Aug. 1990, SWOE report 90-01, 17p., ADA-231 176, 33 refs.

45-1698

INFRARED PHOTOGRAPHY, COMPUTERIZED SIMULATION, DETECTION, MILITARY RESEARCH, SURFACE TEMPERATURE

Background surface temperature models were reviewed and evaluated for implementation in the Smart Weapons Operability Enhancement Program. As a result, current capabilities in one-dimensional modeling were determined and specific recommendations for implementation were made. Robust capabilities exist for solid materials, snow, fresh water and simple vegetation layers. Modeling of freshwater ice and sea ice are tractable at this time. Serious deficiencies exist in complex vegetation because of the mix of materials comprising the canopy and their complex geometry. Simulation of most porous solid materials seems inadequate. Recommendations for specific implementation were made in three groups: atmosphere-material energy fluxes, energy fluxes within materials (for several material types), and the initial model framework. The use of the C language version of the Terrain Surface Temperature Model is recommended to serve as an initial model framework for model development. Recommendations for research and development are made for complex vegetation types, mass transport through porous materials, the land/ocean interface, transitional conditions, and quantitative parameter estimation.

MP 2826

WORKSHOP ON TRACTION MECHANICS ON DEFORMABLE TERRAIN, SOUTH LAKE TAHOE, CA, OCT. 9-11, 1989.

Blaisdell, G.L., ed, *U.S. Army Cold Regions Research and Engineering Laboratory*, Jan. 1990, 37p.

45-1968

MEETINGS, TRACTION, ALL TERRAIN VEHICLES,

SNOW VEHICLES, TRAFFICABILITY, TIRES, TERRAIN

MP 2827

INITIAL IMPRESSIONS OF A CANDIDATE MOBILE OVER-SNOW TRANSPORT SYSTEM. Blaisdell, G.L., Diemand, D., Young, B., *U.S. Army Cold Regions Research and Engineering Laboratory*, Apr. 1990, 13p. + appends., 5 refs.

45-1969

SLEDS, MILITARY TRANSPORTATION, SNOW VEHICLES, ALL TERRAIN VEHICLES, TRACKED VEHICLES

MP 2828

EFFECT OF FINES IN SAND ON FRICTION ON ICE.

Blaisdell, G.L., Borland, S.L., *U.S. Army Cold Regions Research and Engineering Laboratory*, Sep. 1990, 16p. + figs.

45-1970

RUNWAYS, ICE FRICTION, TRACTION, SANDING, FINES

MP 2829

DESIGN OF A MODIFIED CATERPILLAR CHALLENGER TRACTOR FOR ANTARCTIC SERVICE.

Blaisdell, G.L., Kurtz, K., *U.S. Army Cold Regions Research and Engineering Laboratory*, June 1990, 13p. + figs., 2 refs.

45-1976

TRAVERSES, SLEDS, SNOW VEHICLES, TRACTORS, TRACKED VEHICLES

The Caterpillar Challenger tractor, modified by an extended track, is recommended as a replacement for the Caterpillar LGP D8 low-ground-pressure tractor in the National Science Foundation's antarctic vehicle fleet. The LGP D8 tractors are now over 30 years old and many of their parts have become unavailable. The Challenger tractor can be used for pulling tracked trailers or sleds with a payload up to 40 tons and at a top speed of 18 mph.

MP 2830

STATUS OF AIRLAND BATTLEFIELD ENVIRONMENT (ALBE) WINTER TACTICAL DECISION AIDS.

Aitken, G.W., Slota, J.R., *U.S. Army Cold Regions Research and Engineering Laboratory*, Dec. 1990, 14p.

45-1978

VISIBILITY, TRAFFICABILITY, ROUTE SURVEYS, SNOW ROADS, COMPUTER PROGRAMS, MILITARY OPERATION, COLD WEATHER OPERATION

MP 2831

ANTIFREEZE ADMIXTURES FOR COLD WEATHER CONCRETING.

Korhonen, C.J., Cortez, E.R., *Concrete international*, Mar. 1991, 13(3), p.38-41, 10 refs.

45-1983

WINTER CONCRETING, CONCRETE ADMIXTURES, ANTIFREEZES

MP 2832

TOP/BOTTOM MULTISENSOR REMOTE SENSING OF ARCTIC SEA ICE.

Comiso, J.C., Wadhams, P., Krabill, W.B., Swift, R.N., Crawford, J.P., Tucker, W.B., *Journal of geophysical research*, Feb. 15, 1991, 96(C2), p.2693-2709, 26 refs. For another version see 45-564.

45-2042

ICE BOTTOM SURFACE, RADAR ECHOES, ACOUSTIC MEASUREMENT, LIDAR, SEA ICE, PHYSICAL PROPERTIES, REMOTE SENSING, MEASURING INSTRUMENTS, PERFORMANCE, CORRELATION, RADIOMETRY, SYNTHETIC APERTURE RADAR

The arctic sea ice cover has been studied using near simultaneous observations by passive and active (synthetic aperture radar, SAR) microwave sensors, upward looking and sidescan sonars, a lidar profilometer, and an infrared sensor. Aircraft and submarine data over 100 km track of central arctic sea ice were registered and analyzed to evaluate the characteristics of the ice cover and the utility of each sensor in ice studies. The results of comparative and correlation analyses are as follows. The probability density functions of ice draft from sonar and elevation from lidar were found to be almost identical when isostasy is taken into account, which suggests that the basic ice thickness distribution can be derived from the surface topography measurements alone. Reasonable correlation was found between SAR backscatter and ice draft. However, surface roughness derived directly from standard deviations in the lidar elevation data was found to be poorly correlated to the SAR backscatter, which indicates that the SAR values are affected more by scattering from the ice than from the snow-covered surface. The active and passive microwave sensors are shown to generally complement each other in sensitivity to different physical properties of the sea ice. Surfaces identified as multiyear ice by the passive system have a large spread in the

unaveraged SAR backscatter, indicating limitations when using a one-channel SAR for ice type identification at the highest resolution. Also, ridged ice identified by sonar and SAR data covers a large range of passive microwave emissivity, suggesting considerable variability in the age and salinity of this type of ice. Significant variations (about 0.11) in the minimum emissivity of consolidated multiyear ice are observed in different regions of the Arctic using the high-resolution (30 m) passive microwave data. This suggests that regional variations in texture and scattering characteristics of multiyear ice in the Arctic are present, likely influenced by different histories of formation of the ice in different regions.

MP 2833

POTENTIAL RESPONSE OF ANTARCTIC SEA ICE TO CLIMATIC CHANGE INDUCED BY ATMOSPHERIC CO₂ INCREASES.

Ackley, S.F., 1981, 17p. + 3p. refs., Contributed paper to the AAAS report to the Department of Energy on Climatic Impact of Increased CO₂ Changes in the Atmosphere. 30 refs.

45-1930

SEA ICE, CARBON DIOXIDE, CLIMATIC CHANGES

Possible mechanisms are cited by which antarctic sea ice may affect climate. While many mechanisms can be postulated, consideration must be given to the geologic record, relating to correlation between past climatic changes and sea ice action or response, and the state of knowledge about the present day formation and decay of antarctic sea ice, in order to determine, (1) if sea ice will respond to a CO₂ induced climate warming and (2) how this sea ice change will affect climate. Some aspects of the antarctic sea ice are unique, readily apparent, and should be considered before such a decision is made. They include: (a) the location of the antarctic sea ice on the southern boundary of the Southern Hemisphere westerly wind system, in mid-latitudes, a major repository of kinetic energy of the general circulation of the atmosphere. Ice transport from the Weddell Sea strongly affects mid-latitude temperature and presumably circulation in the S. Atlantic region at the present time. (b) The "free" boundary of the southern sea ice with the world ocean, qualitatively at least, reflects a more interactive role with global scale processes than does the Arctic. (c) The role of the entire region south of the Polar Front as a "heat exchanger," where heat taken up by the ocean elsewhere is dissipated, affecting the total heat transport by the oceans and the ocean-atmosphere interaction in polar regions. (d) As part of the heat exchange process, the formation of antarctic sea ice leads to thermohaline processes producing Antarctic Bottom Water and thereby affects the meridional heat and salt transport by oceanic waters, as well as the global cycling of sea waters for nutrient and gas exchange. (Auth. mod.)

MP 2834

MICROWAVE AND PHYSICAL PROPERTIES OF SEA ICE IN THE WINTER MARGINAL ICE ZONE.

Tucker, W.B., et al, *Journal of geophysical research*, Mar. 15, 1991, 96(C3), p.4573-4587, 22 refs.

45-2084

SEA ICE, ICE PHYSICS, MICROWAVES, ICE DENSITY, ICE COVER THICKNESS, ICE SALINITY, RADAR, RADIOMETRY, SYNTHETIC APERTURE RADAR

Surface-based active and passive microwave measurements were made in conjunction with ice property measurements for several distinct ice types in the Fram Strait during Mar. and Apr. 1987. Synthetic aperture radar imagery downlinked from an aircraft was used to select study sites. The surface-based radar scattering cross section and emissivity spectra generally support previously inferred qualitative relationships between ice types, exhibiting expected separation between young, first-year and multiyear ice. Gradient ratios, calculated for both active and passive data, appear to allow clear separation of ice types when used jointly. Surface flooding of multiyear floes, resulting from excessive loading and perhaps wave action, causes both active and passive signatures to resemble those of first-year ice. This effect could possibly cause estimates of ice type percentages in the marginal ice zone to be in error when derived from aircraft- or satellite-borne sensors.

MP 2835

NORTH AMERICAN STANDARD PRACTICES FOR HEAT FLUX AND TEMPERATURE MEASUREMENT IN BUILDING SYSTEMS.

Flanders, S.N., IMEKO (Internationale Messtechnische Konföderation [International Measurement Confederation]) Technical Committee. ITC series, No.9. Heat flux measurement, Budapest, Hungary, OMIKK (Országos Muszaki Információs Központ és Könyvtár [National Technical Information Center and Library])—TECHNOINFORM, 1986, p.101-120, 8 refs. Proceedings of the 2nd Workshop.

45-2098

THERMAL INSULATION, BUILDINGS, HEAT FLUX, TEMPERATURE MEASUREMENT, BUILDING CODES

MP 2836

DETECTION OF COARSE SEDIMENT MOVEMENT USING RADIO TRANSMITTERS.

Chacho, E.F., Jr., Burrows, R.L., Emmett, W.W., *Northern engineer*, Fall 1990, 22(3), p.5-9, 8 refs. For another version see 44-3985.

45-2099

ROCKS, GLACIAL RIVERS, SEDIMENT TRANSPORT, RIVER FLOW, TELEMETERING EQUIPMENT

The use of radio transmitters to track and locate coarse sediment (39 millimeters or larger) was successfully demonstrated by tracking five individual rocks through a highly mobile, braided river system. Radio-implanted rocks traveling distances greater than 1,500 m in 8 days' time were tracked during periods of high flow and turbid water conditions. After flow receded and access to the bars and channels was possible, the rocks were again located and recovered even though burial of up to 0.3 m had occurred. A motion sensing device that detects whether a particle is in motion or at rest was also tested successfully.

MP 2837

ROLLER-COMPACTED CONCRETE PAVEMENT CONSTRUCTION AT FORT DRUM, NEW YORK.

Cortez, E.R., Gerlach, J.A., *Transportation research record*, 1990, No.1282, p.8-17, 5 refs.

45-2088

CONCRETE PAVEMENTS, FROST HEAVE, CONCRETE DURABILITY, FLEXURAL STRENGTH, COLD WEATHER CONSTRUCTION

MP 2838

AIR TEMPERATURE VARIATION OVER SNOW-COVERED TERRAIN.

Hogan, A.W., Ferrick, M.G., *Eastern Snow Conference. Proceedings*, 1990, 47th, U.S. Army Cold Regions Research and Engineering Laboratory. Special report SR 90-44. Edited by M. Ferrick and T. Pangburn, p.1-12, 26 refs.

45-2182

RIVER ICE, ICE AIR INTERFACE, AIR TEMPERATURE, TEMPERATURE VARIATIONS, SNOW COVER EFFECT, SNOW AIR INTERFACE, TERRAIN

December 1989 was not only one of the coldest months for which instrumental records exist in the Northeastern United States, but was also unusual in that the air temperature remained continuously below freezing during all but the last day of the month. This prolonged cold period provided relatively homogeneous meteorological conditions in which to study the relationship among complex terrain variables and early morning air temperatures. An experiment was conducted in the Connecticut River Valley near 43N latitude, based on the hypothesis that the river pool above Wilder Dam would provide a homogeneous surface reference for comparison of air temperatures observed nearby in differing geographic settings. Temperatures were measured 1.5 m above the surface at 92 relocatable points along a 33 km north-south transect and 12 km east-west transect. Morning twilight temperatures measured on five days prior to a 30 cm snowfall on Dec. 16 were compared with temperatures at the same locations on the five following days. Prior to the snowfall, the temperatures near the river were higher than those immediately upslope by more than 2 C. This trend was reversed following the snowfall, with colder air near the river. An analysis is presented to demonstrate that the heat rejected from river ice growth would be sufficient to provide the observed local warming. The quantity of heat available from this source decreased by an order of magnitude coincident with the observed reversal in temperature trends near the river. The influences of terrain slope, vegetation and the "heat island" of a village are also discussed.

MP 2839

MICROSCOPIC OBSERVATIONS OF SNOW DEFORMATION.

Shoop, S.A., Taylor, S., *Eastern Snow Conference. Proceedings*, 1990, 47th, U.S. Army Cold Regions Research and Engineering Laboratory. Special report SR 90-44. Edited by M. Ferrick and T. Pangburn, p.27-38.

45-2184

SNOW COVER STRUCTURE, TRAFFICABILITY, SNOW STRENGTH, SNOW DEFORMATION, SNOW COMPRESSION, MICROANALYSIS

Snow grains subjected to shearing or compressive forces, or both, were examined with a microscope to explore the conditions that cause melting of grains during snow deformation. Researchers have studied the deformation of snow, caused by wheels, tracks, sliders and skis, but little work has been done on snow deformation at a microscopic scale. This information is useful in defining the processes involved in snow deformation and is applicable to research on vehicle mobility and construction on snow, skiing and avalanches. Snow samples were deformed using a variety of instruments and studied via thin sections and single grain observations. In general, the sheared zones contained broken grains, crushed material and aggregates of crushed material. Evidence of melting was observed immediately adjacent to sheared surfaces, and when the pressure and temperature conditions were conducive

to pressure melting. Snow with large, rounded grains showed changes from deformation most clearly.

MP 2840

RECENT DEVELOPMENTS IN SNOW-CHEMISTRY RESEARCH IN THE WESTERN UNITED STATES.

Davis, R.E., Bales, R.C., *Eastern Snow Conference. Proceedings*, 1990, 47th, U.S. Army Cold Regions Research and Engineering Laboratory. Special report SR 90-44. Edited by M. Ferrick and T. Pangburn, p.99-107, 13 refs.

45-2190

CHEMICAL COMPOSITION, GAS INCLUSIONS, MATHEMATICAL MODELS, SNOW COMPOSITION, SNOW IMPURITIES, SNOWMELT, WATER CHEMISTRY

Three active areas of detailed research in snow and ice chemistry are described with emphasis on the connection between processes at different scales: i) modeling chemical hydrographs from seasonal snowpacks in alpine watersheds, ii) studying processes affecting ion redistribution in, and elution from snow, and iii) investigating the interaction of trace gases in snow. First, in alpine watersheds where snowmelt runoff dominates basin hydrology, accurate hydrochemical modeling depends on developing adequate descriptions of snowmelt chemistry. Whole-watershed hydrochemical modeling using point descriptions of snowmelt chemistry, along with distributed estimates of snowmelt volume, is being pursued for the Emerald Lake (Sierra Nevada) and other alpine watersheds in the western U.S. Second, tracer studies at the Sierra Nevada Aquatic Research Laboratory are being used to develop point estimates of snowmelt volume versus chemistry for use in the distributed watershed models. Complementary field studies are ongoing at the U.S. Forest Service's Glacier Lakes site in Wyoming, and the Mammoth Mountain (California) field site of the University of California, Santa Barbara. Third, recent studies by researchers at the University of Arizona and the U.S. Forest Service have used chromatographic methods to examine the interaction of reactive gases (SO₂, H₂O₂) with ice surface, continuing earlier investigations of gaseous deposition to snow.

MP 2841

PROTOTYPE PHYSICALLY-BASED MODEL FOR THE PREDICTION OF THE SPATIAL DISTRIBUTION OF SNOWCOVER.

Sambles, K.M., Harrison, A.R., Anderson, M.G., Pangburn, T., *Eastern Snow Conference. Proceedings*, 1990, 47th, U.S. Army Cold Regions Research and Engineering Laboratory. Special report SR 90-44. Edited by M. Ferrick and T. Pangburn, p.109-119, 22 refs.

45-2191

DATA PROCESSING, SNOW COVER DISTRIBUTION, SNOW DEPTH, SNOWMELT, RUNOFF FORECASTING, MATHEMATICAL MODELS

A prototype digital model, SNOMO, has been developed to predict the pattern of snowcover and snowdepth distribution over a small catchment during the melt season. The catchment is subdivided into homogeneous areas on the basis of elevation, slope angle, aspect and vegetation cover using a GIS driven algorithm. The energy budget of the snowpack is calculated for each area. A simplified version of the snowpack internal structure and characteristics is used to alleviate data availability problems. The energy-budget terms are used to calculate the amount of melt, which is then subtracted from the existing snowpack depth in terms of centimeters of snow. The model has been tested on the W3 watershed (8.4 sq km), part of Sleepers River Research Watershed, Danville, VT. Point predictions are shown to accord well with observed values, and spatial predictions of snow distributions for the complete catchment are presented.

MP 2842

REGIONAL SNOWFALL INTENSITY AND THE GREAT LAKES ANOMALY.

Ryerson, C.C., Bates, R.E., *Eastern Snow Conference. Proceedings*, 1990, 47th, U.S. Army Cold Regions Research and Engineering Laboratory. Special report SR 90-44. Edited by M. Ferrick and T. Pangburn, p.189-199, 14 refs.

45-2198

SNOWFALL, SNOWSTORMS, LAKE EFFECTS, SYNOPSIS METEOROLOGY

Snowfall intensity widely varies spatially and temporally within individual storms and within regions. However, regional snowfall intensity has not been mapped or characterized systematically as a climatic phenomenon. Snowfall intensity was compiled and mapped over the continental United States from four years of National Weather Service 6-hour synoptic reports to show general patterns. Intensities are generally greatest in both eastern and western mountain areas and along the East Coast, and are generally lowest in the northern Plains and Great Lakes. The low Great Lakes intensities were unexpected because of the frequent lake-effect storms along their southeast shores. Methodological and meteorological reasons for this pattern are discussed, and methods of resolving whether the Great Lakes patterns are true are suggested.

MP 2843

PERFORMANCE OF AN OMNIDIRECTIONAL WHEEL ON SNOW AND ICE.

Blaisdell, G.L., *Naval engineers journal*, Jan. 1991, 103(1), p.34-41, 7 refs.

45-2227

TRACTION, DESIGN, AIRCRAFT LANDING AREAS, VEHICLE WHEELS, SNOW COVER EFFECT, ICE COVER EFFECT, MECHANICAL TESTS, PERFORMANCE

This study investigated the suitability of service vehicles equipped with a unique omnidirectional wheel operating aboard aircraft carriers in northern latitudes, where ice and snow on flight decks is not uncommon. It addressed the comparative performance of the omnidirectional wheel, a bias-ply highway tire as used on current Navy MD-3 aircraft tow vehicles, a typical non-pneumatic forklift truck tire, and an automotive radial-ply all-season tire. The tires were tested for driving traction levels on prepared ice, hard-packed snow, and fresh shallow snow. In general, the omnidirectional wheel showed performance superior to the forklift truck tire and the bias-ply highway tire. The radial all-season tire, however, outperformed the omnidirectional wheel in traction on slippery surfaces. The omnidirectional wheel was well-behaved during traction testing and shows promise for operation on winter surfaces. Recommendations are provided that might further improve omnidirectional wheel performance on snow and ice.

MP 2844

STABILITY OF FLOATING AND SUBMERGED BLOCKS.

Daly, S.F., Axelson, K.D., *Journal of hydraulic research*, 1990, 28(6), p.737-752, With French summary. 13 refs.

45-2257

PHYSICAL PROPERTIES, ANALYSIS (MATHEMATICS), ICE FORECASTING, SIMULATION, FLOATING ICE, UNDERWATER ICE, STABILITY, FLUID FLOW, HYDRODYNAMICS

The rotational stability of floating and submerged rectangular blocks is described. The limit of stability is reached when the overturning moment acting on the block is equal to the maximum hydrostatic righting moment. The hydrostatic righting moment is derived and a convenient expression for its maximum is presented in nondimensional form. A moment coefficient is defined that relates the overturning moment at the limit of stability to the moment produced by the product of the dynamic pressure of the flow and the plan area of the block. An exponential function of the ratio of block thickness to flow depth is postulated as a general expression for the moment coefficient. The parameters of this function are related to the block geometry by analyzing the existing experimental data. The limit of rotational stability for rectangular blocks can then be described in terms of a densimetric Froude number based on block thickness.

MP 2845

COLD REGIONS ENGINEERING.

International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991, Sodhi, D.S., ed, New York, American Society of Civil Engineers, 1991, 790p., Refs. passim. For individual papers see 45-2317 through 45-2387.

45-2316

ICE WATER INTERFACE, ICE LOADS, ICE DETECTION, RECORDING INSTRUMENTS, SOIL FREEZING, FROZEN GROUND STRENGTH, WATER TREATMENT, FROST ACTION, COLD WEATHER CONSTRUCTION, RIVER ICE, ICE MECHANICS, ICE STRENGTH, SNOWDRIFTS

MP 2846

LABORATORY METHODS FOR PREPARING LOW-DENSITY FROZEN SALINE SOIL SAMPLES FOR STRENGTH TESTS.

Ayorinde, O.A., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. *Proceedings*. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.32-43, 2 refs.

45-2320

OFFSHORE STRUCTURES, ANALYSIS (MATHEMATICS), EARTH FILLS, SOIL FREEZING, FROZEN GROUND STRENGTH, ARTIFICIAL FREEZING, ARTIFICIAL ISLANDS, SALINE SOILS

Laboratory methods were developed for preparing low-density frozen saline soil samples with density values ranging from 85-110 lb/cu ft. This range of density values is typical of below-water fill for winter-constructed arctic islands and causeways. These low-density frozen saline soil samples were used for triaxial-compression consolidated-drained (CD) tests to estimate the island/causeway strength. Two laboratory methods found adequate for low-density frozen samples were (a) back-saturating compacted freshwater frozen-soil chunks or lumps with seawater at the freezing temperature, and (b) depositing and consolidating freshwater frozen-soil chunks in a seawater column maintained at the freezing temperature.

MP 2847 LABORATORY STUDY OF SHOCK WAVES IN FROZEN SOIL.

Dutta, P.K., Farrell, D., Kalafut, J., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.54-70, 27 refs.

45-2322 LABORATORY TECHNIQUES, ANALYSIS (MATHEMATICS), FROZEN GROUND MECHANICS, FROZEN GROUND STRENGTH, SHOCK WAVES

This work has focused on two aspects of dynamic behavior of frozen soil: first, on the shock pressure attenuation, and second, on the shock Hugoniot. The use of long bars of frozen soil mounted with a stress transfer cap mated to the Hopkinson pressure bar was investigated as a technique for shock attenuation studies. Hugoniot shock data were obtained from the high stress level impact on the specimens in the Hopkinson pressure bar (HPB) by applying the elementary theory of unidirectional stress propagation. Wave attenuation from low-level impact was exponential but the results are suspected to be influenced by wave dispersion and shear deformation effects. Hugoniot data were obtained over only a small deformation range, owing to the short (250-microsecond) wavelength developed by the HPB apparatus.

MP 2848 SLUDGE DEWATERING IN FREEZING BEDS.

Martel, C.J., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.108-115, 6 refs.

45-2326 FREEZE DRYING, ARTIFICIAL THAWING, SLUDGES, ARTIFICIAL FREEZING, WATER TREATMENT

This paper summarizes the results of laboratory and pilot scale studies on the development of the sludge freezing bed. Laboratory studies indicated that a freezing bed could dewater up to 2.0 m of typical water and wastewater sludges. Pilot plant results indicated that adequate drainage during thaw was critical for odor control. After thawing, the sludge was dry enough for removal with mechanical equipment. The cost of constructing a freezing bed was estimated to be considerably higher than that of an equivalent drying bed. However, this extra expense would be more than offset by higher loading rates and lower operation and maintenance costs.

MP 2849 FREEZE-THAW EFFECTS ON CLAY COVERS AND LINERS.

Chamberlain, E.J., Ayorinde, O.A., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.136-151, 18 refs.

45-2329 SOIL FREEZING, SOIL STABILIZATION, SOIL COMPACTION, WASTE DISPOSAL, CLAY SOILS, FREEZE THAW CYCLES, PERMEABILITY

This report reviews laboratory experiments on the effects of freezing and thawing on the permeability of clayey soils and develops compaction requirements to minimize damage to clay layers caused by freezing and thawing. Permeability increases greater than two orders of magnitude have been observed. The smallest changes in permeability occurred when the soils were compacted to high densities. The authors show how a relationship between the percent increase in permeability and the liquidity index of the soil affects the acceptable range of moisture contents and densities required for compaction. A simple method for estimating the acceptable zone based on the plastic limit and the degree of saturation is also provided.

MP 2850 THERMAL REGIME SURROUNDING A LONGITUDINAL EDGE DRAIN.

Allen, W.L., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.164-177, 3 refs.

45-2331
PAVEMENTS, WATERPROOFING, FROST HEAVE, SEASONAL FREEZE THAW, RUNWAYS, DRAINS, DRAINAGE
Newton Airfield in Jackman, Maine, was constructed in 1986 to perform as a drained pavement system. The drainage design consisted of a permeable base course with a longitudinal edge drain along one side of the runway. The drain was placed 5 1/2 to 7 ft below the pavement surface to provide service throughout the freezing season. Initial observations of the site showed that during the winter, outflow from the drain outlet stops. Problems with the performance of the system were observed in the form of water coming up through the pavement surface and flowing over the top

of the pavement. A hypothesis was proposed that frozen soil material was blocking the flow of water into the drain structure. Instrumentation placed to monitor the ground freezing regime around the drain indicated that the drainage system and the pavement structure thaw relatively quickly. A closer look at the pavement geometry and the permeability of the base course indicated that the base course cannot provide the flow capacity to drain the water available from snow melt during the spring thaw period.

MP 2851 NUMERICAL ANALYSIS OF FROST SHIELDS.

Coutermarsh, B.A., Phetteplace, G.E., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.178-190, 12 refs.

45-2332 PIPELINE INSULATION, SOIL FREEZING, FROST PROTECTION, THERMAL INSULATION, MATHEMATICAL MODELS, UNDERGROUND PIPELINES, FROST PENETRATION

A finite element heat transfer program has been developed to assess the practicality of currently used frost shielding techniques by allowing the designer to model frost penetration using different burial depths, insulation schemes and backfill materials around the utility line. The information obtained is then used to perform an economic analysis on the possible schemes to determine the most cost-effective solution to the problem. This paper discusses the program development and rationale. Also discussed are the particulars of finite element modeling and the necessary precautions that must be followed when this method is used. Verification is demonstrated by numerical approximation with analytical solutions and by presenting actual frost penetration data obtained under controlled conditions in the CRREL Frost Effects Research Facility. Some sample results for promising frost shield applications are presented along with an example of the cost savings possible.

MP 2852 COMPUTER PREDICTIONS OF THAW BENEATH GRAVEL EMBANKMENTS ON WARM PERMAFROST.

Bigl, S.R., Berg, R.L., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.191-199, 7 refs.

45-2333 COMPUTERIZED SIMULATION, EMBANKMENTS, PERMAFROST BENEATH ROADS, GROUND THAWING, THAW DEPTH

The model, using a one-dimensional finite-difference code, FREZID, predicted that a gravel embankment can be constructed on an ice-rich clay permafrost without generating excessive amounts of thaw settlement. Gravel embankments thicker than 19 ft are predicted to contain thaw penetrations for a 10-yr period experiencing air temperatures similar to the 1976-86 decade. Thinner embankments will require additional treatments to prevent thaw from penetrating the permanently frozen clay. Inclusion of extruded polystyrene insulation at 2 ft below the gravel surface was extremely effective in reducing thaw penetration depths.

MP 2853 NEW ADMIXTURES FOR COLD WEATHER CONCRETING.

Korhonen, C.J., Cortez, E.R., Smith, C.E., Jr., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.200-209, 7 refs.

45-2334 CONCRETE STRENGTH, CONCRETE CURING, WINTER CONCRETING, CONCRETE ADMIXTURES, ANTI-FREEZES

Chemicals were tested for their ability to promote strength gain in portland cement concrete at low temperature. The admixtures depressed the freezing point of the mix water and accelerated the hydration of cement at low temperature. Tests were conducted at -5 and -10 C. The results show that low-temperature strength gain of antifreeze concrete can be comparable to that of additive-free concrete cured at room temperature. These additives, so-called "antifreeze admixtures" have potential for use in the cold regions.

MP 2854 PROCESSED-SNOW FOUNDATION DESIGN AT THE SUMMIT OF THE GREENLAND ICE CAP.

Curtis, K.C., Tobiasson, W., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York,

American Society of Civil Engineers, 1991, p.240-249.

45-2337 RESEARCH PROJECTS, ICE SHEETS, SNOW COMPACTION, SNOW (CONSTRUCTION MATERIAL), SNOW STABILIZATION, FOUNDATIONS, EMBANKMENTS, GREENLAND

The design and construction of a processed-snow foundation berm for an elevated building located at the summit of the Greenland Ice Cap is described. Weather conditions and design provisions at the Greenland Ice Sheet Project (GISP) 2 site are described. Undisturbed snow densities are compared to processed-snow densities measured in the compacted foundation berm.

MP 2855 EVOLUTION OF ICE COVER ROUGHNESS.

Ashton, G.D., Zufelt, J.E., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.294-305, 11 refs.

45-2341 RIVER FLOW, ICE COVER EFFECT, ICE WATER INTERFACIAL ANALYSIS (MATHEMATICS), RIVER ICE, ICE FORMATION, SURFACE ROUGHNESS, ICE BOTTOM SURFACE, ICE COVER THICKNESS

The formation of an ice cover on a river results in an increase of stage relative to open water stages at the same discharge. Due to the formation process, especially for freeze-up ice jams, the underside of the ice cover is very rough initially and smooths with time. Observations in the field have shown considerable reductions of stage or head loss with time. Three mechanisms responsible for the evolution of ice cover roughness are investigated: freeze smoothing, melt smoothing, and depositional smoothing. While these mechanisms have previously been noted as the cause of smoothing with time, this paper presents quantitative estimates of the magnitude of roughness changes based on the physics of the three processes.

MP 2856 CONCEPTUAL MODEL FOR VERTICAL FRAZIL DISTRIBUTION IN TURBULENT FLOWS.

Liou, C.P., Ferrick, M.G., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.336-347, 30 refs.

45-2345 HEAT TRANSFER, ICE FORMATION, ICE WATER INTERFACIAL ANALYSIS (MATHEMATICS), FRAZIL ICE, ICE MODELS, TURBULENT FLOW

A conceptual model is presented for the evolution of frazil over depth in a turbulent flow. The net upward migration due to buoyancy of the frazil is opposed by intermittent mixing induced by large energy-containing eddies. A surface renewal model is adopted to describe the large eddy mixing. Averages over an ensemble of discrete local volumes for the concentration profile, surface age and surface layer thickness are obtained with a probability density function. A dimensionless surface renewal frequency characterizes the frazil distribution at equilibrium as either well-mixed or layered. The model provides a physical basis for understanding the transition between these conditions, and is consistent with existing empirical criteria and field data.

MP 2857 RIVER ICE MANAGEMENT (RIM) PROGRAM: DEVELOPING NEW OPTIONS FOR WATERWAYS OPERATIONS IN WINTER.

Carey, K.L., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.376-385, 7 refs.

45-2349 RESEARCH PROJECTS, CHANNELS (WATERWAYS), LOCKS (WATERWAYS), DAMS, MANUALS, RIVER ICE, ICE CONTROL, ICE NAVIGATION

Most of the navigable inland waterways of the United States are utilized year-round. In northern portions of this network (mainly parts of the Ohio and Upper Mississippi River basins), ice reduces transportation efficiency and interferes with the operation of Corps of Engineers locks and dams. In parallel with Corps programs for rehabilitation or replacement of certain aging and inadequate locks and dams (averaging about 50 years old), the Corps' five-year River Ice Management (RIM) Program developed ways to incorporate structural improvements in new and existing navigation projects, and examined new operational techniques, all aimed at improving waterway operations in the presence of the ice. RIM Program studies focused on four functional areas: a) improving ice-conditions information to aid decision-making by the Corps and the navigation industry; b) helping locks and dams cope with ice in winter operations; c) influencing river ice formation and movement; and d) easing winter navigation operations in

the vicinity of Corps projects. Several RIM Program demonstrations provided immediate improvements to winter operations. An Engineer Manual was produced giving uniform direction to Corps Districts in matters involving river ice, and containing guidance for studies leading to River Ice Management Plans for specific basins, mainstem rivers, or tributaries.

MP 2858 SMALL-SCALE METEOROLOGY OF FREEZING PRECIPITATION.

Hogan, A.W., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.454-462, 8 refs.

45-2357

TOPOGRAPHIC EFFECTS, ICE STORMS, GLAZE, PRECIPITATION (METEOROLOGY)

Freezing rain and glazing are extremely disruptive to transportation, communication and power transmission. Local variations in the occurrence of freezing rain may be difficult to forecast. This paper describes terrain-induced temperature differences, and provides an analysis showing terrain-induced cold air retention during warm advection. Calculations indicate that it may be possible to locally ameliorate freezing rain in valleys with more than 300 m of local relief.

MP 2859 ANELASTIC STRAINING IN POLYCRYSTAL-LINE ICE.

Cole, D.M., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.504-518, 26 refs.

45-2362

ICE STRENGTH, ICE CREEP, ICE CRYSTAL STRUCTURE, ICE MECHANICS, ICE DEFORMATION, ICE ELASTICITY

This paper presents experimental observations on the influence of stress, grain size and total strain level on the magnitude of anelastic strain in granular freshwater ice. Cyclic loading experiments carried out at low total strain levels indicate that the anelastic strain is a function of grain size. Strain recovery experiments, wherein the specimens were deformed to strains as high as 0.07, indicate that the anelastic strain reaches a maximum value at relatively low total strain levels and thereafter remains relatively constant. The results indicate for a given ice type, that when the total strain level is relatively high (e.g. >0.01), the anelastic strain is no longer a function of grain size, but only of temperature and stress level. A nonlinear relationship between the anelastic strain and applied stress level emerged for the strain recovery experiments. A dislocation-based model that explains the stress dependency is developed and is seen to represent the experimental observations reasonably well. The grain size dependency of the internal friction is explained qualitatively in terms of the structure of grain boundaries. Discussions center on the development of a unified dislocation-based view of the anelastic strain observed under all experimental conditions.

MP 2860 PRELIMINARY RESULTS OF DIRECT TENSION TESTS ON FIRST-YEAR SEA ICE SAMPLES.

Richter-Menge, J.A., Claffey, K.J., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.569-578, 15 refs.

45-2367

ICE MECHANICS, ICE LOADS, TEMPERATURE EFFECTS, SEA ICE, ICE STRENGTH, STRAIN TESTS, TENSILE PROPERTIES

The initial results of the tests are presented to determine the tensile behavior of columnar sea ice over a range of temperatures extending from -20 to -3 C and strain rates of 100,000/s and 1000/s. The temperature of a test specimen was dictated by its in-situ location within the sheet; samples located near the top of the sheet were tested at the lower temperature. All samples were taken from the horizontal plane of the ice sheet. The maximum stress achieved during a test was most notably influenced by temperature, while loading rate was the primary variable in determining the failure strain and the modulus.

MP 2861 EFFECTIVE PRESSURES MEASURED DURING INDENTATION TESTS IN FRESHWATER ICE.

Sodhi, D.S., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.619-627, 7 refs.

45-2372

ICE DEFORMATION, ICE LOADS, ICE SOLID INTER-FACE, ICE STRENGTH, ICE PRESSURE, IMPACT TESTS

Indentation tests were conducted by pushing flat, vertical indentors of two different widths (50 and 100 mm) against the edges of floating freshwater ice at different velocities (0.6-150 mm/s). The stiffness of the indenter support system and the ice thickness were in the range of 0.8-3.5 MN/m and 18-57 mm, respectively. Three different modes of ice-structure interactions were observed: creep deformation at low velocities, intermittent crushing at intermediate velocities and continuous crushing at high velocities. The maximum effective pressures measured at different indenter velocities were found to differ by a factor of 3 to 5; high pressures (8-13 MPa) were measured at low indenter velocities (<20 mm/s), and low pressures (1.2-4.3 MPa) at high indenter velocities (>100 mm/s).

MP 2862

SPRAY AND ICE MEASUREMENT INSTRUMENTATION FOR SHIPS.

Ryerson, C.C., Walsh, M.R., Knuth, K.V., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.748-757, 5 refs.

45-2384

ICE FORECASTING, RECORDING INSTRUMENTS, MEASURING INSTRUMENTS, SHIP ICING, SEA SPRAY, ICE DETECTION, THICKNESS GAGES

Bow slamming is the primary water delivery mechanism for ship superstructure icing. Spray flux is largely dependent upon hull dynamics, and cannot be computed numerically with current understanding of hydrodynamic processes. Therefore, ship icing models must rely upon empirical algorithms for water delivery. The Cold Regions Research and Engineering Laboratory has developed an instrumentation system that automatically measures spray flux and ice growth for use in icing forecast model development and validation. Though the spray measurement system is similar in concept to a rain gauge and the ice measurement system is similar to an ultrasonic camera rangefinder, the systems are more complex because of their need to operate reliably on a ship deck in heavy weather. This paper describes the design, testing, construction, and fielding of this equipment.

MP 2863

USACRREL UNDERWATER FRAZIL ICE DETECTOR.

Daly, S.F., Rand, J.H., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.758-764, 1 ref.

45-2385

UNDERWATER ICE, FRAZIL ICE, ICE DETECTION, RECORDING INSTRUMENTS

A modified underwater frazil ice detector has been developed at USACRREL. This detector, which operates remotely, can automatically start deicing procedures and alert operators to the presence of frazil. The detector operates by monitoring the flow rate through a small intake screen. The intake screen is, in effect, a miniature trash rack that will allow frazil ice to accumulate much quicker than the actual trash racks. This patent-pending detector was tested in the laboratory and in field conditions. The system is an economical solution to the early detection of frazil ice.

MP 2864

RECOMMENDED COLD REGIONS METEOROLOGICAL INSTRUMENTATION.

Bates, R.E., International Cold Regions Engineering Specialty Conference, 6th, West Lebanon, NH, Feb. 26-28, 1991. Proceedings. Edited by D.S. Sodhi. Cold regions engineering, New York, American Society of Civil Engineers, 1991, p.772-783, 12 refs.

45-2387

HUMIDITY, AIR TEMPERATURE, WIND (METEOROLOGY), PRECIPITATION (METEOROLOGY), METEOROLOGICAL INSTRUMENTS, WEATHER OBSERVATIONS, COLD WEATHER PERFORMANCE

The northern temperate climatic zones experience a varying scenario of winter environmental extremes of cold, icing, and precipitation, which severely influence people, equipment and operations. Even instruments designed to measure cold and/or wet adverse environments may be incapable of operation if employed during severe cold weather. It is important to know the equipment's environmental restrictions and to evaluate the frequency and duration of disabling weather. In some instances, functional impairments persist after the causative meteorological conditions have subsided, e.g., glaze, rime and heavy snow and ice accumulation. For nearly 30 years, CRREL has studied environmental conditions in winter weather. These efforts have concentrated on providing field-measured meteorological data, as well as instrumentation support for many experiments conducted throughout cold regions of the Northern Hemisphere. These

efforts have involved characterizing atmospheric conditions as well as surface conditions. This paper will discuss instrumentation currently being used to gather atmospheric and background environmental data during winter field testing. Current state-of-the-art developments such as a new laser diode for measuring relative humidity will be discussed. Finally a brief summary of data gathered and data analysis methods will be presented.

MP 2865

HEAT TRANSFER WITH FREEZING AND THAWING.

Lunardini, V.J., Developments in geotechnical engineering, No.65, Amsterdam, Elsevier Science Publishers, 1991, 437p., Refs. passim.

45-2390

BOUNDARY VALUE PROBLEMS, TEMPERATURE EFFECTS, SOIL FREEZING, GROUND THAWING, POROUS MATERIALS, HEAT TRANSFER, PHASE TRANSFORMATIONS, ANALYSIS (MATHEMATICS), FREEZING, THAWING, LIQUID SOLID INTERFACES

MP 2866

NEW WETTING CURVES FOR COMMON ROOF INSULATIONS.

Tobiasson, W., Groatorex, A., Van Pelt, D., International Symposium on Roofing Technology, 3rd, 1991. Proceedings. Building a worldwide roofing community, Rosemont, IL, National Roofing Contractors Association, 1991, p.383-390, 11 refs.

45-2461

VAPOR PRESSURE, TEMPERATURE EFFECTS, THERMAL CONDUCTIVITY, ROOFS, THERMAL INSULATION, MOISTURE

Specimens of common roof insulations were placed in an apparatus that maintained an air temperature of 4 C and 75% relative humidity (RH) above the insulation, and 29 C and 100% RH (or 70% RH) below. The specimens were periodically removed from this apparatus, weighted, wrapped in a thin plastic film and then tested in a thermal conductivity instrument with its top plate maintained at about 4 C and its bottom plate at about 29 C. After a specimen's insulating ability was determined in this instrument according to the ASTM C 518-76 procedure, it was returned to the apparatus for further wetting. Some insulations accumulated moisture rapidly, but others gained very little moisture even after years of testing. The ratio of a material's wet thermal resistivity to its dry thermal resistivity, expressed as a percentage, is termed its thermal resistance ratio (TRR). As moisture accumulates in a material, its TRR decreases. Graphs of TRR vs. moisture content were developed for fiberglass, perlite, cork, gypsum, insulating concrete, cellular glass, fibrous glass, expanded polystyrene, extruded polystyrene, urethane/isocyanurate, foamed-in-place urethane and phenolic insulations. TRR vs. moisture content equations have also been developed for each material. Insulation with a TRR of 80% or less is deemed 'wet' and unacceptable. The moisture content at which the TRR equals 80% is tabulated for these materials.

MP 2867

BANK RECESSION AND CHANNEL CHANGES NEAR DIKES ON THE TANANA RIVER, ALASKA.

Gatto, L.W., D.B. Simons Symposium on Erosion and Sedimentation. Proceedings. Edited by R.M. Li and P.F. Lagasse, American Society of Civil Engineers, 1983, p.4.2-4.21, 8 refs.

45-2492

WATER EROSION, CHANNELS (WATERWAYS), BANKS (WATERWAYS), BANK PROTECTION (WATERWAYS), RIVERS, UNITED STATES—ALASKA—TANANA RIVER

Two dikes were built from the Tanana River levee into the Tanana River in 1975 and 1979 as part of a flood control project. New dikes will be constructed wherever it appears likely that bank recession will encroach into the 500 ft safe zone between the levee and the north bank of the river. The objectives of this analysis were to measure linear bank recession and bank land lost, to evaluate relationships between bank erosion and dike construction, and to describe channel changes before and after construction. Aerial photographs were used to map historical bankline positions and to document channel changes from 1948 to 1982. Most bank recession near the dikes occurred along the north channel prior to construction. After construction the dikes diverted flows away from the north bank, and bank erosion increased along the islands and south bank. Both dikes effectively reduced north bank erosion at sites immediately downstream. However, it appears that this solution may be temporary. The river is re-establishing its preconstruction length in the reaches where the dikes were built by forming meanders at the ends of the dikes. The river is again attacking the north bank downstream of the preconstruction locations, and erosion rates at some of these new sites are high.

MP 2868

IN SEARCH OF LIBRARY EXCELLENCE IN COLD REGIONS RESEARCH.

Liston, N.C., Education and continuing development for the civil engineer, New York, American Society

of Civil Engineers, 1990, p.1066-1069.

45-2580

EDUCATION, ORGANIZATIONS, RESEARCH PROJECTS, DATA PROCESSING, BIBLIOGRAPHIES

In the age of the information explosion, engineers and librarians must work together to achieve a value-added research product. The importance of the librarian's role in the research process was never more important than it is today in a world of diminishing resources and expanding demands. This paper presents a special engineering librarian's view of how the information specialist will enhance the research process in the 1990s.

MP 2869

PREDICTION OF ERRORS FOR IN-SITU MEASUREMENT OF THERMAL RESISTANCE.

Flanders, S.N., Mack, R.T., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, Feb. 1991, SR 91-03, In-situ heat flux measurements in buildings; applications and interpretations of results. Edited by S.N. Flanders, p.193-219, ADA-234 924, 17 refs.

45-2659

THERMAL INSULATION, COMPUTER PROGRAMS, MATHEMATICAL MODELS, BUILDINGS, HEAT FLUX, TEMPERATURE MEASUREMENT, THERMAL CONDUCTIVITY

A sufficient measurement time is key to the accurate determination of thermal resistance from in-situ heat flux and temperature data. Given some assumed thermal properties of the construction to be measured, this paper presents a means for predicting an error that might result from anticipated temperature conditions or for estimating the error that may be attributable to a temperature history. The error-prediction procedure is useful for deciding in advance whether to make in-situ thermal resistance measurements, during expected temperature conditions, of buildings and of structures that contain hot or cold media. This procedure estimates errors in the calculation of thermal resistance only, that result from obtaining non-steady-state temperature and heat flow data over a finite period of time. Random errors due to instrumentation techniques should be analyzed separately, using propagation of errors or other methods. Errors that result from changes in the apparent thermal conductivity of the constituent materials of the element studied are also beyond the scope of this paper. Such changes may be due to variation in internal temperatures, moisture migration or air movement.

MP 2870

THERMISTOR-BASED SYSTEM FOR THERMAL CONDUCTIVITY MEASUREMENT.

Atkins, R.T., Wright, E.A., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, Feb. 1991, SR 91-03, In-situ heat flux measurements in buildings; applications and interpretations of results. Edited by S.N. Flanders, p.223-236, ADA-234 924, 7 refs.

45-2660

ANALYSIS (MATHEMATICS), THERMAL INSULATION, SOIL TEMPERATURE, SLUDGES, THERMAL CONDUCTIVITY, TEMPERATURE MEASUREMENT, THERMISTORS

This report describes a patented method for using commercially available thermistors to make in-situ thermal conductivity measurements with commonly available electronic equipment such as digital voltmeters. The emphasis is on the use of a single thermistor to measure the thermal conductivity of soils. Calibration techniques are explained and examples provided. Limits on this technique are discussed, including measurement range, material grain size, the amount of material needed for a valid measurement, and temperature stability. Specific examples of the use of this technique are provided for thermal conductivity measurements of soils, building materials, and the sludges in a sewage treatment plant. Data analysis is provided, including a statistical approach to finding the thermal conductivity in large volumes of material.

MP 2871

LAYERED CHARACTER OF SNOW COVERS.

Colbeck, S.C., *Reviews of geophysics*, Feb. 1991, 29(1), p.81-96, 99 refs.

45-2828

SNOW HYDROLOGY, SNOW MECHANICS, SNOW STRATIGRAPHY, SNOW COVER STRUCTURE, METAMORPHISM (SNOW)

Snow studies have generally ignored the layered nature of snow covers. Having achieved a good understanding of the properties and processes in homogeneous snow, snow scientists should develop more insight into the evolution of the layers and their effects on overall snow response. Many of the outstanding problems in snow studies can only be solved by dealing with snow as a layered medium. The various mechanisms by which layers are generated, their effects, and some of the outstanding research problems are described here.

MP 2872

SURFACE RADAR INVESTIGATIONS OF AN ICING MOUND ON THE SAGAVANIRKOTOK RIVER, ALASKA.

Arcone, S.A., Chacho, E.F., Jr., Collins, C.M., Delaney, A.J., International Conference on Ice Technology, 2nd, Cambridge, England, Sep. 18-20, 1990. Proceedings. Edited by T.K.S. Murthy, J.G. Paren, W.M. Sackinger and P. Wadhams, Southampton, England, Computational Mechanics Publications, 1990, p.353-363, 9 refs.

45-2744

ICE WATER INTERFACE, SUBSURFACE INVESTIGATIONS, WATER RESERVES, RIVER ICE, FROST MOUNDS, WATER STORAGE, DETECTION, RADAR ECHOES, ICE SURVEYS

A short-pulse radar survey was carried out on the surface of a water-bearing icing mound on the Sagavanirktok River on Alaska's North Slope in Apr., 1989. The purpose was to map the extent of the subsurface water-filled cavity contained within the icing mound formation. Such mounds represent a possible winter water resource for exploration and development activities. The investigated mound was approximately 2.3 m high and over 110 m long. All radar profiles, made both parallel and perpendicular to the long axis of the mound, recorded water surface reflections, but only along the ends of the longitudinal profile were reflections received from the bottom of the water cavity; apparently rugged bottom relief prevented signals from being received from the water bottom. Snow depth and ice surface elevation were measured along all cross sections, and ice thickness and water depth were measured at a few locations along the cross sections. The radar data were then used with the drilling data to estimate the shape and dimensions of the water cavity. It appears that the mound was located in a small meander bend of one of the channels, with the cavity positioned over the pool and extending to the riffles at both ends. The water volume is estimated at about 900 cu m.

MP 2873

PARTICLE BEAM SIMULATION.

Hopkins, M.A., Mechanics computing in 1990s and beyond, New York, American Society of Civil Engineers, 1991, p.1274-1278, 5 refs. Proceedings of the ASCE conference, Columbus, OH, May 2-22, 1991.

45-2829

MATHEMATICAL MODELS, ICE JAMS, PRESSURE RIDGES, COMPUTERIZED SIMULATION

A two-dimensional beam simulation is developed in which the beam is composed of uniform rectangular blocks. Internal forces in the beam are caused by relative motion between adjoining blocks. A viscous-elastic-plastic force model is used. Tensile or compressive failure of the beam occurs when stresses in the top or bottom surfaces exceed the strength of the material. The simulation is numerically explicit and completely consistent with existing discrete particle simulations. For this reason, it is especially suited for modeling problems in which a beam undergoes periodic failure, creating a rubble accumulation as blocks are broken from the parent beam. Two such problems are ice jamming in northern rivers and sea ice ridging in the Arctic.

MP 2874

VERNAL ATMOSPHERIC MIXING IN THE ANTARCTIC.

Murphy, B.B., Hare, T., Hogan, A.W., Lieser, K., Toman, J., Woodgates, T., *Journal of applied meteorology*, Apr. 1991, 30(4), p.494-507, 54 refs.

45-2842

AEROSOLS, STORMS, CLOUDS (METEOROLOGY), WEATHER OBSERVATIONS, OZONE, ANTARCTICA—MCMURDO STATION, ANTARCTICA—AMUNDSEN-SCOTT STATION

Aerosol concentration, ozone concentration, and meteorological parameters were measured at McMurdo and South Pole Stations during a spring storm that reached the antarctic interior. Nacreous clouds were sighted preceding the storm, indicative of stratospheric flow from lower latitudes. These measurements and observations, along with upper-air and surface analyses, indicate that vigorous tropospheric/stratospheric exchange of air occurs near 75S during the spring. The elemental composition of collected aerosol changed coincidentally with different stages of the storm. During the storm event in Sep. 1983, surface ozone concentration varied from 20 to more than 100 ppbv at McMurdo, but remained less than 20 ppbv at the South Pole indicating that deep mixing, which occurred at the periphery of Antarctica during the spring storm, did not continue over the interior of the continent. The warm marine air associated with the spring coastal storm infiltrated the interior of Antarctica including the Polar Plateau, producing a record surface temperature and an aerosol concentration twice the September mean. This system was unusual as the warm front apparently reached the surface of South Pole. Crustal material was transported to the periphery of Antarctica through the upper troposphere or lower stratosphere. Enhanced aerosol concentration was transported to the South Pole through the lower troposphere. Vigorous exchange occurred at latitudes of greater than 78S, which probably exchanged both marine aerosol and water vapor into the lower stratosphere. (Auth.)

MP 2875

ICE CONDITIONS ON INLAND WATERWAYS.

Frankenstein, G.E., Rand, J.H., Wortley, C.A., International Navigation Congress, 27th, Osaka, Japan, May 20-26, 1990. Proceedings, Brussels, Permanent International Association of Navigation Congresses, [1990], p.61-65, With French summary. 16 refs.

45-2647

FRAZIL ICE, CHEMICAL ICE PREVENTION, ELECTRIC HEATING, LOCKS (WATERWAYS), RIVER ICE, ICE CONTROL, ICE CONDITIONS, ICE NAVIGATION

MP 2876

PHASE-CHANGE NUMERICAL HEAT TRANSFER ANALYSIS WITH APPLICATIONS TO FROST SHIELDING.

Farag, I.H., Virameteekul, N., Phetteplace, G.E., *Heat transfer engineering*, 1991, 12(2), p.29-36, 26 refs.

45-2915

MATHEMATICAL MODELS, FREEZING FRONT, UNDERGROUND PIPELINES, PHASE TRANSFORMATIONS, HEAT TRANSFER, THERMAL INSULATION, FROST PROTECTION

A computer package has been developed to solve heat transfer problems with phase change and predict the temperature distribution and phase-front location variation with time. The fixed-mesh package incorporates latent heat effects. The time-domain solution uses a central-difference procedure. Published results on freezing of slab-shaped foodstuffs, solidification in an internal corner, a solidification outside a 270 deg wedge, and solidification of cast steel are used to demonstrate the validity of the numerical technique and the capabilities of the program. Underground freezing of pipelines with and without frost shields is studied using this package, and the results are discussed.

MP 2877

BANK AND CHANNEL CHANGES NEAR DIKES, TANANA RIVER, ALASKA.

Gatto, L.W., River meandering. Conference Rivers '83, New Orleans, LA, Oct. 24-26, 1983. Proceedings. Edited by C.M. Elliott, New York, American Society of Civil Engineers, 1983, p.212-222, 5 refs.

45-2957

BANKS (WATERWAYS), CHANNELS (WATERWAYS), EROSION

Two dikes on the Tanana River diverted river flow away from the north bank which stopped north bank erosion immediately downstream of the dike locations, and bank erosion increased along some of the southern channels. The river, however, appears to be reestablishing its preconstruction length by forming meanders at the ends of the dikes, and is eroding the north bank downstream of the sites that were eroding prior to construction. Statistical analysis of erosion and discharge data showed that bank erosion increases the longer the discharge is above 30,000 cfs (840 cu.m./s). Although cross-sectional areas of the channels did not change substantially, major lateral shifts occurred in the northern channels. Most north channel changes occurred on the rising limb of the discharge hydrograph, while the south channel changed most as discharge receded. Data from this analysis and other studies will be used in selecting sites for additional dikes.

MP 2878

PROCEEDINGS. VOL.4.

International Conference on Offshore Mechanics and Arctic Engineering, 10th, Stavanger, Norway, June 23-28, 1991, Ayorinde, O.A., ed, Sinha, N.K., ed, Nixon, W.A., ed, Sodhi, D.S., ed, New York, American Society of Mechanical Engineers, 1991, 287p., Refs. passim. For individual papers see 45-3141 through 45-3180.

45-3140

MATHEMATICAL MODELS, SEA ICE, ICE STRENGTH, ICE ISLANDS, OFFSHORE STRUCTURES, ICE (CONSTRUCTION MATERIAL), ICE SOLID INTERFACE, OFFSHORE DRILLING, ENGINEERING, ICE LOADS, ICE MECHANICS

MP 2879

APPROXIMATE ANALYSIS OF THE TEMPERATURE DISTRIBUTION IN COMPOSTING MATERIAL IN A COLD ENVIRONMENT.

Ayorinde, O.A., Lunardini, V.J., International Conference on Offshore Mechanics and Arctic Engineering, 10th, Stavanger, Norway, June 23-28, 1991. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, W.A. Nixon, and D.S. Sodhi, New York, American Society of Mechanical Engineers, 1991, p.87-92, 25 refs.

45-3153

TEMPERATURE DISTRIBUTION, ANALYSIS (MATHEMATICS), COLD WEATHER TESTS

An approximate analytical solution method was developed to

quantify the distribution of temperatures in a compost pile at different low temperatures. Since composting is a temperature self-limiting process, the analysis of the temperature distribution of a compost pile in a cold environment is essential and desirable. The theoretical temperature distribution within the compost pile was calculated using an approximate analytical solution of the conductive heat transfer equation with a term for heat generated by microbial activity. For the analysis the composting material was considered to be homogeneous, which is a reasonable assumption since thorough mixing is always required for composting systems. In addition an idealized cylindrical shape was assumed, which is a good approximation for most reactor-type compost piles. Effects of ambient temperature, compost initial temperature and thermal diffusivity were also determined. Forced and free convective heat transfer effects were also evaluated. Published data on the heat production rate for different composting materials were used to estimate temperature distributions. The approximate analytical solution helps to identify significant parameters and to evaluate their influence on the performance of the composting system. The exact solution also provides a means of quantifying the distribution of microbially produced heat in the composting material. This type of solution, coupled with information on the effects of the environment on by-product fate and toxicity, could be used to guide optimal designs for cost-effective compost systems.

MP 2880 LABORATORY TESTS WITH A HYBRID THERMOSYPHON.

Haynes, F.D., Zarling, J.P., Quinn, W.F., Gooch, G.E., International Conference on Offshore Mechanics and Arctic Engineering, 10th, Stavanger, Norway, June 23-28, 1991. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, W.A. Nixon, and D.S. Sodhi, New York, American Society of Mechanical Engineers, 1991, p.93-99, 10 refs.

45-3154

THAW DEPTH, PIPES (TUBES), SOIL STABILIZATION, FLUID FLOW, HEAT TRANSFER, FOUNDATIONS, PERFORMANCE, DESIGN, THERMAL CONDUCTIVITY
A passive-active thermosiphon, equipped with an internal condensate return device that delivered 70% of the condensate to the far end of the horizontal evaporator section, was tested in the laboratory. In the passive mode, the test variable was the wind speed across the vertical condenser section as the air temperature was held constant at -8 C. In the active mode, mechanical refrigeration lines were connected to a heat exchanger built into the standard commercial thermosiphon. The test variables in the active mode were air temperature and the mass flow rate of the refrigerant. A hybrid thermosiphon has the advantages of both a passive unit and an active unit.

MP 2881 QUANTIFYING THE EFFECT OF SPATIAL VARIABILITY IN INSULATION MOISTURE CONTENT PROFILES USING A NONDESTRUCTIVE TECHNIQUE.

Ayorinde, O.A., Pidgeon, D.E., International Conference on Offshore Mechanics and Arctic Engineering, 10th, Stavanger, Norway, June 23-28, 1991. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, W.A. Nixon, and D.S. Sodhi, New York, American Society of Mechanical Engineers, 1991, p.101-105, 6 refs.

45-3155

THERMAL INSULATION, MOISTURE TRANSFER, COLD WEATHER CONSTRUCTION
A nondestructive technique using a dual-energy gamma-ray (DEGR) device was successfully applied to accurately measure the moisture profiles across the thicknesses of three types of insulation material exposed to water and subjected to a constant temperature gradient. The three types of insulation were expanded-bead polystyrene, urethane and perlite. The nondestructive method has also been used to continuously track and measure moisture migration and distribution in the insulating materials under prolonged exposure to moisture and thermal gradients. Similar measurements cannot be done by current destructive methods of determining insulation moisture profiles by a post-test slicing or cutting of the insulation. For this study a DEGR device was also used to evaluate the spatial variability in the across-thickness moisture profiles at three locations along the length of each insulation slab. The moisture profiles were measured at the midpoint (center) and at the quarter points (three inches left and right of the midpoint) along the insulation length. The average moisture contents at the three locations were also determined by calculating the across-thickness statistical mean values at these locations. The average of the mean values at the three locations was compared with the gravimetrically determined average moisture content for each type of insulation. The experimental results and analysis indicated that, for all the types of insulation tested, there were noticeable changes in the moisture profiles and average moisture contents at the three locations along the insulation length, showing the effect of spatial variability. The results also showed that the spatial variability in the moisture content profile depends on the type of insulation. Compared with the four-week gravimetric average volumetric moisture content of 0.115 cu cm/cu cm for polystyrene, the average volumetric

moisture content was 0.137 cu cm/cu cm at the left quarter point, 0.129 cu cm/cu cm at the midpoint and 0.101 cu cm/cu cm at the right quarter point along the insulation length. For urethane the gravimetric value was 0.071 cu cm/cu cm compared to 0.081 cu cm/cu cm, 0.079 cu cm/cu cm and 0.067 cu cm/cu cm, respectively, at similar locations. However, for perlite the average volumetric moisture content was 0.274 cu cm/cu cm, 0.294 cu cm/cu cm and 0.285 cu cm/cu cm, respectively, at these locations compared to the gravimetric value of 0.306 cu cm/cu cm. This type of evaluation can be achieved only by a nondestructive technique.

MP 2882 SMALL-SCALE EXPERIMENTS ON SPLITTING OF ICE FLOES.

Sodhi, D.S., International Conference on Offshore Mechanics and Arctic Engineering, 10th, Stavanger, Norway, June 23-28, 1991. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, W.A. Nixon, and D.S. Sodhi, New York, American Society of Mechanical Engineers, 1991, p.171-175, 13 refs.

45-3166

ICE FLOES, ICE SOLID INTERFACE, ICE CRACKS, VELOCITY, ICE COVER THICKNESS

When small-scale indentation tests were conducted by pushing a flat, vertical indenter against the edges of floating freshwater ice sheets at low velocities, a macrocrack always formed in front of the indenter. When the indenter was made to impact against free-floating ice floes at high velocities, the floes did not split. The difference in these results is attributed to the different modes of ice deformation at different indenter velocities relative to ice. For low velocity tests, the ratio of crack opening force to ice pushing force is estimated from experimental data and existing theoretical results in the literature.

MP 2883 FIELD OBSERVATIONS OF STRESSES IN YOUNG ICE.

Perovich, D.K., Tucker, W.B., International Conference on Offshore Mechanics and Arctic Engineering, 10th, Stavanger, Norway, June 23-28, 1991. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, W.A. Nixon, and D.S. Sodhi, New York, American Society of Mechanical Engineers, 1991, p.191-198, 17 refs.

45-3169

PACK ICE, YOUNG ICE, STRESSES, SEA ICE

An accurate understanding of in-situ pack ice forces is of critical importance in improving ice forecasting models and in generating estimates of loads on offshore structures. Young ice plays an important but poorly understood role in determining the internal stress field in sea ice. For one month, in-situ ice stress measurements were obtained in young first-year ice in the eastern Arctic during the fall of 1988. Sensors were also placed in an adjacent multi-year floe. During extreme deformation events, peak stresses briefly reached 400 kPa in both the young ice and in multi-year ice. During periods of dynamic activity, stresses in young ice and in multi-year ice were well correlated. Typically, stresses were largest in the young ice and were rapidly attenuated with distance from the edge of the multi-year floe. From day 314 to 320, twice daily oscillations of about 50 kPa due to tides or inertial oscillations were apparent in the stress data.

MP 2884 EVALUATION OF AN IMPACT TEST FOR MEASURING ICE ADHESION STRENGTH.

Andersson, L.O., Lever, J.H., Mulherin, N.D., Rand, J.H., International Conference on Offshore Mechanics and Arctic Engineering, 10th, Stavanger, Norway, June 23-28, 1991. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, W.A. Nixon, and D.S. Sodhi, New York, American Society of Mechanical Engineers, 1991, p.215-220, 19 refs.

45-3172

ICE ADHESION, IMPACT TESTS, IMPACT STRENGTH

Lack of standardized testing has hampered efforts to understand ice adhesion and develop low-adhesion materials. However, the American Society for Testing and Materials (ASTM) specifies numerous standards for testing adhesive joints. The authors plan to adopt one of these standards for ice-adhesion tests, with ice substituted for the adhesive. Here, the authors describe the first effort in this program: adaptation of ASTM D950 (Impact strength of adhesive bonds). Basically, the authors installed ice-bonded test specimens in an Izod impact machine and measured the energy needed to debond the specimens. The main advantage of this test is its simplicity; many samples can be inexpensively prepared and tested. Its disadvantages include a restriction on specimen size and the generation of a nonuniform stress field. This paper describes the test procedures and results, and discusses their implications for standardized ice-adhesion testing.

MP 2885 MEASURING THE EFFECTIVENESS OF DEICING FLUIDS FOR REDUCING ICE ADHESION TO ROUGH SURFACES.

Lever, J.H., Rand, J.H., McGilvary, W.R., Interna-

tional Conference on Offshore Mechanics and Arctic Engineering, 10th, Stavanger, Norway, June 23-28, 1991. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, W.A. Nixon, and D.S. Sodhi, New York, American Society of Mechanical Engineers, 1991, p.221-227, 15 refs.

45-3173

ICE ADHESION, AIRCRAFT LANDING AREAS, ICE PREVENTION

Through a series of laboratory tests, the effectiveness of eight different deicing fluids was examined for reducing ice adhesion to the rough, nonskid surfaces used on aircraft-landing areas of ships. The nonskid samples consisted of 46 x 46 cm coated steel plates having roughness peaks of 2-3 mm. On each sample, a light coating of deicer was first sprayed and then a uniform layer of freshwater glaze ice was accreted. The very rough, nonskid surfaces and the ice-deteriorating effect of deicing chemicals dictated a novel approach to measuring adhesion strength: the ice was loaded inertially by bouncing the iced samples off a stiff spring. The average shear adhesion strength was calculated by measuring the acceleration required to shed the ice. A relatively small amount of deicer (similar to 70 mL/sq m) applied in advance of ice accretion was found to be extremely effective in reducing ice adhesion to nonskid surfaces. Without deicer, cohesive failure occurs within the ice (at shearing stresses of about 2,000 kPa for the test temperature of -4 C), whereas all deicer-treated samples shed ice, on average, at 130 kPa or less. Furthermore, the best results (similar to 70 kPa) qualify the deiced nonskid surface as a practical, low-adhesion surface for freshwater ice accretions. Such results suggest that advance application of deicing chemicals would significantly assist ice removal from other rough surfaces (asphalt, concrete, etc.). The inertial-load apparatus developed here is well suited for ice adhesion studies of rough surfaces and yielded very low scatter for identically prepared samples. (Auth. mod.)

MP 2886 ICE SCAVENGING AND NUCLEATION: TWO MECHANISMS FOR INCORPORATION OF ALGAE INTO NEWLY-FORMING SEA ICE.

Ackley, S.F., *Eos*, Jan. 19, 1982, 63(3), p.54-55, Abstract only.

45-3409

SEA ICE, SCAVENGING, NUCLEATION, MARINE BIOLOGY, ALGAE, CRYOBIOLOGY

MP 2887 ALGAL AND FORAM INCORPORATION INTO NEW SEA ICE.

Ackley, S.F., Dieckmann, G.S., Shen, H., *Eos*, Dec. 15, 1987, 68(50), p.1736, Abstract only.

45-3410

MARINE BIOLOGY, SEA ICE, ALGAE, CRYOBIOLOGY

MP 2888 U.S. ARMY WHEELED VERSUS TRACKED VEHICLE MOBILITY PERFORMANCE TEST PROGRAM—REPORT 2: MOBILITY IN SHALLOW SNOW.

Green, C.E., Blaisdell, G.L., *U.S. Army Engineer Waterways Experiment Station. Geotechnical Laboratory. Technical report*, May 1991, GL-91-7, 48p. + appends., 2 refs.

45-3446

MILITARY TRANSPORTATION, VELOCITY MEASUREMENT, TIRES, ACCURACY, SNOW VEHICLES, MODELS, TRACKED VEHICLES, PERFORMANCE, TRACTION, SNOW COVER EFFECT, MECHANICAL TESTS, MILITARY RESEARCH

This study evaluates the mobility performance of four wheeled and five tracked vehicles. Mobility tests were conducted on snow by the US Army Engineer Waterways Experiment Station and the US Army Cold Regions Research and Engineering Laboratory (CRREL) at the Keweenaw Research Center near Houghton, MI, to determine traction (drawbar pull/motion resistance), slope negotiation, GO/NOGO, braking, and traverse negotiation. The vehicles were tested to develop fundamental mobility relations between vehicle characteristics and snow properties, validate specific snow relations in CRREL's snow mobility model, and modify the model as necessary to improve its prediction accuracy and adapt it for use in the NATO Reference Mobility Model, Army Mobility Model, and the Condensed Army Mobility Model System.

MP 2889 NONEVAPORATIVE PRECONCENTRATION TECHNIQUE FOR VOLATILE AND SEMIVOLATILE SOLUTES IN CERTAIN POLAR SOLVENTS.

Jenkins, T.F., Miyares, P.H., *Analytical chemistry*, July 1, 1991, 63(13), p.1341-1343, 11 refs.

45-3447

SOIL ANALYSIS, SOIL POLLUTION, PHASE TRANSFORMATIONS, CHEMICAL ANALYSIS, SAMPLING, SOLUBILITY, LABORATORY TECHNIQUES, SALT WATER

In this paper, a simple nonevaporative preconcentration technique has been developed that is useful for miscible solvents that can be salted-out of aqueous solution. The procedure requires only the use of sodium chloride and deionized water, accurate volumetric measurements, and a magnetic stirrer. The method has been successfully demonstrated to preconcentrate both volatile and semivolatile organic solutes with a wide range of polarity. If a suitable solvent is used for extraction, this procedure gives the analyst an alternative to evaporative preconcentration. This has obvious implications for preconcentration of thermally labile compounds. If the preconcentrated extract is used in conjunction with purge-and-trap technology, at least an order of magnitude improvement in detection capability is possible. If the selected solvent is suitable for direct injection, analysts may be able to avoid the use of purge-and-trap technology for certain applications, thereby increasing throughput and decreasing analytical costs.

MP 2890**RECENT PROGRESS IN SNOW AND ICE RESEARCH.**

Richter-Menge, J.A., Colbeck, S.C., Jezek, K.C., *Reviews of geophysics. Supplement*, Apr. 1991, p.218-226, Refs. p.222-226. 45-3451

RESEARCH PROJECTS, BIBLIOGRAPHIES, ICE SHEETS, ICE MECHANICS, SNOW COVER

Snow and ice research during the past quadrennial covers a wide range of topics varying from the climatic effects of large ice sheets and sea ice covers to applied problems such as the icing of power lines and communication facilities. This review focuses in more detail on three topics of the many subjects investigated to provide a more coherent look at the advances achieved and prospects for the future. These are: the influences of layers in seasonal snow covers; research in ice mechanics on freshwater and sea ice; and remote sensing of polar ice sheets. These topics provide useful examples of the general needs in snow and ice research applicable to most areas, e.g. better representation in models of detailed processes, carefully controlled laboratory experiments to quantify processes, and field studies to provide the appropriate context for interpretation of processes from remote sensing.

MP 2891**TEST METHODS TO CHARACTERIZE LOW TEMPERATURE CRACKING.**

Janoo, V.C., Vinson, T.S., Haas, R.C.G., Bayer, J., Jr., Workshop on Paving in Cold Areas, 4th, Sapporo, Japan, Sep. 4-6, 1990. Proceedings. Vol.1, Tsukuba, Japan, Ministry of Construction, Public Works Research Institute, 1990, p.257-287, 52 refs. 45-3500

COLD STRESS, ANALYSIS (MATHEMATICS), TENSILE PROPERTIES, STRAIN TESTS, PAVEMENTS, CRACKING (FRACTURING), THERMAL STRESSES

Thermal cracking of asphalt concrete pavements is a serious problem in the northern tier states of the coterminous U.S. and in Alaska, Canada, Japan and parts of Europe. One theory on the cause of thermal cracking is that the thermally induced tensile stress in the asphalt concrete exceeds its tensile strength. Cracks that result from this condition are called low temperature cracks. Another theory is that thermal cracks occur when the pavement structure is thermally fatigued by daily temperature cycles. As part of a cooperative study by CRREL and U.S. Strategic Highway Research Program A003, a research project was established to investigate thermal cracking. Prior to starting the project, a literature review was conducted on current test methods for characterizing asphalt concrete behavior at low temperatures and/or under thermal cycling. The objective of the survey was to determine the types of tests and equipment currently used, the properties measured by the respective tests, and the degree to which the tests simulate actual field conditions. The purpose of this paper is to present the results of this review.

MP 2892**NATURAL CONVECTION IN THE SUBARCTIC SNOW COVER.**

Sturm, M., Johnson, J.B., *Journal of geophysical research*, July 10, 1991, 96(B7), p.11,657-11,671, 58 refs. 45-3463

SOIL TEMPERATURE, METAMORPHISM (SNOW), MASS TRANSFER, SNOW AIR INTERFACE, SNOW COVER, SNOW PERMEABILITY, AIR FLOW, CONVECTION, SNOW TEMPERATURE, TEMPERATURE MEASUREMENT
The purpose of this study was to determine if air convects in a natural snow cover. To detect convection, the temperature field in the subarctic snow cover in Fairbanks, AK, was measured hourly during three winters using thermistors which were suspended on threads and allowed to be buried by snowfall. The results indicate that convection occurred both sporadically in 1984-1985 and almost continuously in 1985-1986 and 1986-1987. The evidence was (1) simultaneous warming and cooling at different locations in a horizontal plane in the snow, and (2) horizontal temperature gradients of up to 16 C/m. During the winter, warm and cold zones developed in the snow and remained relatively fixed in space. These zones appear to be the result of a diffuse plume-like convection pattern linked to spatial variations in the temperature

of the snow-soil interface. Air flow was inferred to have been primarily horizontal near the base of the snow and vertical elsewhere. The convective circulation was time-dependent, with perturbations such as high wind or rapid changes in air temperature triggering periods when horizontal temperature gradients were strongest, suggesting that these were also periods when the air flow was fastest. The coincidence of depth hour crystals with horizontal c axes and the horizontal flow lines at the base of the snow suggests that convection may have affected crystal growth directions.

MP 2893**WHITE PHOSPHOROUS LINKED AS CAUSE OF WATERFOWL DEATHS AT ALASKAN FIRING RANGE. Environmental update, July 1991, p.5. 45-3455****MILITARY FACILITIES, ANIMALS, POLLUTION, ENVIRONMENTAL IMPACT, WETLANDS****MP 2894****FRACTURE AND BREAKUP OF RIVER ICE COVER: DISCUSSION AND REPLY.**

Demuth, M.N., Prowse, T.D., Beltaos, S., Daly, S.F., *Canadian journal of civil engineering*, Apr. 1991, 18(2), p.336-339, 13 refs. For article being discussed see 44-3702. 45-3537

ICE BREAKING, FLEXURAL STRENGTH, RIVER ICE, ICE JAMS, ICE BREAKUP, ICE COVER STRENGTH, ICE MECHANICS**MP 2895****ARCTIC RESEARCH OF THE UNITED STATES, VOL.5.**

U.S. Interagency Arctic Research Policy Commission, Brown, J., ed, Bowen, S.L., ed, Cate, D.W., ed, Valliere, D.R., ed, Washington, D.C., Spring 1991, 99p., 35 refs. 45-3544

ORGANIZATIONS, COST ANALYSIS, MEETINGS, INTERNATIONAL COOPERATION, RESEARCH PROJECTS, LEGISLATION**MP 2896****TWENTY YEARS OF ICE SYMPOSIA.**

Frankenstein, G.E., IAHR Symposium on Ice, 10th, Espoo, Finland, Aug. 20-23, 1990. Proceedings, Vol.1, [1990], p.43-65. 45-3564

ICE, MEETINGS, HISTORY**MP 2897****PREDICTION OF RESERVOIR FREEZE-UP.**

Ashton, G.D., Mulherin, N.D., IAHR Symposium on Ice, 10th, Espoo, Finland, Aug. 20-23, 1990. Proceedings, Vol.1, [1990], p.124-135, 8 refs. 45-3570

RESERVOIRS, FREEZE-UP, SIMULATION, WATER TEMPERATURE

One of the critical gaps that persists in reservoir water temperature and quality modeling is in the ability to know the temperature of the water at the time of freezeover. Prior to and after freezeover, existing simulation models are capable of following the temperature structure reasonably well, but the "after" simulation requires starting values or the time of initial ice cover formation. The few existing year-round simulation models either impose the ice cover when the 0 C surface temperature is reached or use a heuristic set of threshold criteria proposed by Ashton. The latter has not been well tested and the former is known to fail at times, particularly when wind prevents formation of a stable ice cover. The authors set out to determine what conditions of wind, water temperature, and air temperature lead to the freezeover recorded at the mainstem dams of the Missouri River. The authors tested the criteria proposed by Ashton, a modified version of those criteria, and an index approach where the daily index is a combination of air temperatures, release water temperatures, and wind speeds. The limitations of an index approach are discussed, including the irregular behavior of freezeover and the conceptual difficulty of assessing how the ice cover gains sufficient integrity to withstand forces of wind and current during its formative stages.

MP 2898**EXPERIMENTAL OBSERVATIONS OF SHOVING AND THICKENING: COMPARISON TO EQUILIBRIUM THICKNESS THEORY.**

Zufelt, J.E., IAHR Symposium on Ice, 10th, Espoo, Finland, Aug. 20-23, 1990. Proceedings, Vol.1, [1990], p.500-510, 6 refs. 45-3602

ICE COVER THICKNESS, ICE MECHANICS, ICE WATER INTERFACE, ICE MODELS

While several models have been developed over the past 25 years to simulate ice cover progression and the shoving and thickening

process, it remains as one of the least understood topics in ice hydraulics. Most models are based on some adaptation of equilibrium ice thickness theory, and treat ice shoving and thickening as a steady or quasi-steady process. During ice shoving, the water and ice flows are highly unsteady. Discharge is constantly changing as a result of ice transport and deposition under the cover. The interaction between the flows of ice and water is very complex, and except at the ice surface, it is almost impossible to observe in nature. As a first step to improve the understanding of shoving and thickening, several series of experiments were conducted to observe and document the process. The experiments were conducted in laboratory flumes using real and plastic ice. Stable brash ice accumulations were formed in the flume, and the discharge was then varied to induce shoving and thickening. Hydraulic and ice data were gathered, including velocity, ice thickness, and jam length. These observations are presented, and the data are compared to results from equilibrium-based models. Differences between the experimental and theoretical results are identified, and explanations for these differences are given.

MP 2899**LABORATORY INVESTIGATION OF TRASH RACK HEATING TO PREVENT FREEZEUP BY FRAZIL ICE.**

Daly, S.F., Haynes, F.D., Garfield, D.E., Gagnon, J.J., IAHR Symposium on Ice, 10th, Espoo, Finland, Aug. 20-23, 1990. Proceedings, Vol.2, [1990], p.584-595, 12 refs. 45-3609

DESIGN, COLD WEATHER TESTS, WATER INTAKES, HYDRAULIC STRUCTURES, CHANNELS (WATERWAYS), FREEZEUP, FRAZIL ICE, ELECTRIC HEATING, ICE CONTROL

There have been no systematic studies of heated trash racks under frazil ice conditions, so a heated, model intake trash rack was observed in the refrigerated flume facility at USACRREL, Hanover, NH. Supercooled water and frazil ice were generated in this facility and allowed to pass through the model trash rack. In each test a near constant upstream head was maintained and the discharge through the trash rack was allowed to vary. A novel and efficient means of applying heat is described. The heat transfer rate from the rack was measured and is described in terms of non-dimensional parameters. The discharge rates through the rack as a function of time and heat application rate are described. Based on these observations, an approach to quantify the design of heated trash racks is proposed.

MP 2900**MODEL SURFACE TREATMENT FOR TESTING IN ICE.**

Tatinclaux, J.C., Martinson, C., IAHR Symposium on Ice, 10th, Espoo, Finland, Aug. 20-23, 1990. Proceedings, Vol.2, [1990], p.766-775, 6 refs. 45-3627

METAL ICE FRICTION, EXPERIMENTATION, COATINGS, MODELS, SURFACE PROPERTIES, SHIPS, SIMULATION, ICE SOLID INTERFACE

Forces due to ice friction may represent a significant portion of the total forces exerted on a floating or grounded structure subjected to ice action. In model tests, one of the parameters that must be specified is the kinetic friction factor, $f(i)$, between the model ice and the surface of the model structure. This paper describes a method of surface treatment of a model structure with an appropriate mixture of silica powder and paint which allows a prescribed friction factor to be achieved. This surface treatment method has the advantage of eliminating previous trial-and-errors that were often very time consuming. Other methods of surface treatment for the same purpose of obtaining a given ice kinetic friction factor are known to exist but are often proprietary and have not been published in the open literature.

MP 2901**PREDICTION OF THE HORIZONTAL PROGRESSIONS OF ARCTIC ICE BY REMOTE METHODS.**

Frankenstein, S., Frankenstein, G.E., IAHR Symposium on Ice, 10th, Espoo, Finland, Aug. 20-23, 1990. Proceedings, Vol.2, [1990], p.1113-1121, 10 refs. 45-3658

OCEAN CURRENTS, WATER TEMPERATURE, SALINITY, SEA ICE DISTRIBUTION, ICE CONDITIONS, ICE FORECASTING, SPACEBORNE PHOTOGRAPHY, AIR ICE WATER INTERACTION, ICE GROWTH, RADIOMETRY, SYNTHETIC APERTURE RADAR

Satellites are a tool with which seasonal ice conditions in the Arctic Ocean may be studied. During the fall, when new ice growth is at a maximum, it is necessary to make observations at wavelengths at which atmospheric water vapor is transparent, due to the presence of high cloud concentrations during these months. The scanning multichannel microwave radiometer, and the upcoming SAR are passive response satellites that operate at frequencies which will make it possible to distinguish open water from first-year and multi-year ice. To break these signals down into frazil/new ice and other categories, it is necessary to combine the satellite observations with heat flux calculations. To do this, weather data for the area of interest are needed, which are avail-

able globally on a nearly real-time basis. The only other information needed to approximate the heat flux is the water or ice surface temperature. If no such data exist, a reasonable estimate of the water temperature can be obtained from published monthly sea-surface charts, and surface ice temperatures determined from equations developed from studies on the relationships between air/water temperatures and the concurrent ice thickness. Combining the satellite data and the resulting heat flux calculations into a model, it is thus possible to follow the growth of first-year ice into the open water in a given area. With the advent of the SAR satellite, these estimates can be done in real time, thus providing an important tool for analyzing offshore operations in the arctic shelf seas.

MP 2902

REPORT OF WORKING GROUP ON ICE MODELING MATERIALS.

Timco, G.W., Tatinclaux, J.C., IAHR Symposium on Ice, 10th, Espoo, Finland, Aug. 20-23, 1990. Proceedings, Vol.3, [1990], p.81-98.

45-3668

ICE MECHANICS, ICE MODELS

MP 2903

WINTER HABITATS OF ATLANTIC SALMON AND BROOK TROUT IN SMALL ICE-COVERED STREAMS.

Calkins, D.J., IAHR Symposium on Ice, 10th, Espoo, Finland, Aug. 20-23, 1990. Proceedings, Vol.3, [1990], p.113-126, 34 refs.

45-3670

COLD WEATHER SURVIVAL, ICE COVER EFFECT, ECOLOGY, CRYOBIOLOGY, RIVER ICE, ANIMALS

A review of winter habitat studies conducted in ice-covered streams for two species of salmonids (Atlantic salmon and brook trout) provided some general information on substrate conditions, flow velocities and depths. Brook trout fry are usually found at depths of less than 40 cm and at focal velocities of 5 cm/s or less; juveniles of the same species are found at velocities of less than 17 cm/s but at slightly greater depths. Atlantic salmon young-of-the-year and parr (age 1) were found in the one study to be in the substrate and the velocities at the 0.6 depth in 40-45 cm of water were 40-45 cm/s. The size of substrate used by all salmonids is a function of fish size, with both species preferring a combination of sand, gravel and rubble. Silt in high concentrations is detrimental to sustaining a natural fish population. A lack of continuous physical, chemical and biological measurements throughout the ice-covered season was a common deficiency of the studies reviewed, indicating a need for more interdisciplinary work.

MP 2904

ON THE MOTION OF RIVER ICE NEAR A BREAKING FRONT.

Ferrick, M.G., Weyrick, P.B., IAHR Symposium on Ice, 10th, Espoo, Finland, Aug. 20-23, 1990. Proceedings, Vol.3, [1990], p.201-213, 4 refs.

45-3677

ANALYSIS (MATHEMATICS), ICE MECHANICS, RIVER FLOW, ICE BREAKUP, RIVER ICE

A time series of ice velocity data was obtained from videotape of the initial 300 s of motion at a point during a controlled dynamic ice breakup of the Connecticut River. A polynomial fit to the data provides a smooth velocity-time relationship that eliminates the noise in the data, and identifies the primary ice motion. The hydraulic radius associated with the ice cover changes continuously with the ice velocity. The authors expand the analysis by assuming a constant breaking front speed and consistent ice velocity behavior through a reach local to the measurement site. The results obtained include the total ice acceleration, the equilibrium ice velocity as a function of bank stress, the time-varying bank resistance at the measurement location, the convergence behavior of the moving ice sheet and the influence of breaking front speed on this behavior, and the ice continuity implications of these results at the breaking front.

MP 2905

FREQUENCY OF INTERMITTENT ICE CRUSHING DURING INDENTATION TESTS.

Sodhi, D.S., Nakazawa, N., IAHR Symposium on Ice, 10th, Espoo, Finland, Aug. 20-23, 1990. Proceedings, Vol.3, [1990], p.277-289, 13 refs.

45-3682

ICE STRENGTH, ICE PRESSURE, ICE LOADS, PENETRATION TESTS, ICE SOLID INTERFACE

The results of small-scale indentation tests with freshwater ice are analyzed to obtain the frequency of intermittent crushing failure. From the experimental results, a correlation is obtained between the average distance travelled by an indenter during successive failure events and the maximum relative displacement of the indenter with respect to the carriage during the loading phase of a cycle. From this correlation, the frequency of intermittent crushing can be obtained in terms of structural stiffness, ice velocity, effective pressure, indenter width, and the ice thickness.

MP 2906

PREDICTING PAVEMENT RESPONSE DURING THAW WEAKENING PERIODS USING THE FALLING WEIGHT DEFLECTOMETER.

Janoo, V.C., Berg, R.L., International Conference on Bearing Capacity of Roads and Airfields, 3rd, Trondheim, Norway, July 3-5, 1990. Proceedings, Vol.1. Edited by R.S. Nordal et al., Trondheim, Norway, Norwegian Institute of Technology, 1990, p.31-40, 14 refs.

45-3689

MECHANICAL TESTS, SOIL MECHANICS, BEARING STRENGTH, PAVEMENTS, MEASUREMENT, FREEZE THAW TESTS, THAW WEAKENING, THAW DEPTH, SUB-GRADE SOILS

Pavement structures in northern regions are subjected to seasonal temperature changes. It is important for pavement engineers to have a tool for determining the structural capacity of a pavement during thaw weakening periods. Tests were conducted at the U.S. Army Cold Regions Research and Engineering Laboratory to study the performance of pavement structures during thaw periods. During the thaw period, temperature and deflection measurements were obtained. The results of the deflection measurements are presented in this paper. A method is also presented for estimating the thaw depth using frequent falling weight deflectometer measurements.

MP 2907

EXPERIMENTAL COMPARISON OF EPA AND USATHAMA DETECTION AND QUANTIZATION CAPABILITY ESTIMATORS.

Grant, C.L., Hewitt, A.D., Jenkins, T.F., *American laboratory*, Feb. 1991, p.15-33, 18 refs.

45-3735

DETECTION, STATISTICAL ANALYSIS, WASTES, POLLUTION, CHEMICAL ANALYSIS

MP 2908

GEOTEXTILES AS CAPILLARY BARRIERS.

Henry, K.S., *Geotechnical fabrics report*, Mar.-Apr. 1990, p.30-36, 12 refs.

45-3736

FROST HEAVE, FROST PROTECTION, SOIL STABILIZATION, GEOTEXTILES, CAPILLARITY, THERMAL INSULATION, SOIL FREEZING

MP 2909

EFFECT OF GEOTEXTILES ON WATER MIGRATION IN FREEZING SOILS AND THE INFLUENCE OF FREEZING ON PERFORMANCE.

Henry, K.S., *Geosynthetics '91 Conference*, 1991, p.469-483, 10 refs.

45-3737

CAPILLARITY, FROST PROTECTION, SOIL STABILIZATION, FROST HEAVE, GEOTEXTILES, SOIL FREEZING, SOIL WATER MIGRATION, THERMAL INSULATION

It is believed that certain geotextiles can be used in place of granular capillary breaks to reduce frost heave because they have relatively large pore sizes and their fibers tend to repel water. An experimental program was conducted to verify that geotextiles reduce frost heave by inhibiting water flow to the freezing front, and to examine the performance of soil-geotextile samples when subjected to more than one freeze-thaw cycle. The addition of a needle-punched fabric reduced frost heave rate in the test soil by an average of 65%, while a heat-bonded fabric reduced frost heave by 37%. The presence of needle-punched fabric resulted in very high soil moisture tensions and soil pressure gradients above the fabric during freezing. Both of these conditions would decrease water flow rates to the portion of the soil which is freezing. Results of tests in which a soil/fabric system was subjected to three freeze/thaw cycles indicate little, if any, influence on the fabric's ability to reduce frost heave. Estimates of unsaturated hydraulic conductivities were made by using Darcy's law in conjunction with measured soil pressure gradients in the soil and assumed water flow rates based on the rate of frost heave. The results of this procedure suggest that there is a relationship between soil moisture tension and hydraulic conductivity in the frozen fringe and conditions in the unsaturated soil below the freezing front.

MP 2910

PILOT SCALE STUDIES OF SLUDGE DEWATERING IN A FREEZING BED.

Martel, C.J., Diener, C.J., National Conference on Environmental Engineering, Hamilton, Ontario, May 15-18, 1990. Proceedings, Canadian Society for Civil Engineering, [1990], 15p., 8 refs.

45-3738

FREEZE DRYING, FREEZE THAW CYCLES, SLUDGES, ARTIFICIAL FREEZING, WATER TREATMENT, SEWAGE TREATMENT

In 1986, a pilot scale sludge freezing bed was constructed at the U.S. Army Cold Regions Research and Engineering Laboratory in Hanover, NH, USA. This bed was operated for the next three

years using both anaerobically and aerobically digested sludges. Results indicate that both sludges were effectively dewatered by this process. The final solid contents were 39.3% and 24.5% for anaerobically digested and aerobically digested sludges respectively. The quality of the meltwater from the bed was similar to that of raw wastewater. The actual depth of sludge frozen and thawed in the bed during each year of operation was very close to that predicted by design models. The maximum depth of sludge frozen during this study was 1.14 m. Operational experience demonstrated the importance of a sand layer at the bottom of the bed for adequate drainage. Also, odors developed when the meltwater was allowed to accumulate in the bed. Odors were not a problem when the meltwater was drained away as quickly as it formed. All sludges were easily removed with a front end loader.

MP 2911

PHASE CHANGE HEAT TRANSFER ANALYSIS WITH APPLICATIONS TO FROST SHIELDING.

Farag, I.H., Virametekul, N., Phetteplace, G.E., International Heat Transfer Conference, 9th, Jerusalem, Aug. 19-24, 1990. Proceedings, Vol.3. Heat transfer 1990, Washington, D.C., Hemisphere Publishing Corporation, [1990], p.9-13, 19 refs. For another version see 45-2915.

45-3739

MATHEMATICAL MODELS, UNDERGROUND PIPELINES, PHASE TRANSFORMATIONS, HEAT TRANSFER, THERMAL INSULATION, FROST PROTECTION

A computer package has been developed to solve heat transfer problems with phase change and to predict the temperature distribution and phase front location variation with time. The fixed-mesh package incorporates latent heat effects. The time domain solution uses a central difference procedure. Underground freezing of pipelines with and without frost shields is studied using this package, and the results are discussed.

MP 2912

SOLVENT-WATER PARTITIONING AND EXTRACTION OF PHOSPHONATES.

Leggett, D.C., *U.S. Army Chemical Research Development and Engineering Center. Special publication*, Aug. 1990, CRDEC-SP-024, p.889-895, 18 refs. Included in the proceedings of the Scientific Conference on Chemical Defense Research, Nov. 14-17, 1989.

45-3740

WATER CHEMISTRY, SOIL CHEMISTRY, SOLUTIONS, POLLUTION, WASTE TREATMENT, MILITARY RESEARCH, CHEMICAL PROPERTIES

Phosphonates are used as G-agent simulants in a number of applications. Partitioning of dimethyl methylphosphonate (DMMP) between water and various solvents was examined with a view toward optimization of solvent extraction methods for this class of compounds. The results of these partitioning experiments indicate that the best solvents for extraction of DMMP from water are H-donors, suggesting H-bonding as the principal mechanism. Advantage was also taken of the universal salting-out effect; saturating the aqueous phase with NaCl increased the partition coefficient of DMMP six-fold (0.78 log units), irrespective of the solvent. By analogy, similar results may be expected for other low molecular weight phosphonates, phosphites, phosphates and phosphonofluoridates.

MP 2913

SIMULANT INTERACTION WITH ICE AND AGENT PERSISTENCE ESTIMATION FOR COLD REGIONS.

Leggett, D.C., *U.S. Army Chemical Research Development and Engineering Center. Special publication*, Dec. 1988, CRDEC-SP-002, p.237-247, 22 refs. Included in the proceedings of the 2nd International Simulant Workshop.

45-3741

SOLUBILITY, ICE COMPOSITION, SIMULATION, POLLUTION, IMPURITIES, CHEMICAL PROPERTIES, MILITARY RESEARCH

The role of ice surfaces in determining G-agent persistence in cold regions is examined. A solubility model is used with available data to predict the weathering of agents on snow due to evaporation and hydrolysis. The results compare well with experiment, but the model cannot be validated for other agents without more information. The data most critically needed are the solubility of water (ice) in agents and their unbuffered hydrolysis rates in water.

MP 2914

LONGITUDINAL DISPERSION IN OVERLAND FLOW OF WASTEWATER.

Adrian, D.D., Martel, C.J., Cambridge, Massachusetts Institute of Technology, [1990], p.1-8, 3 refs. For presentation at the International Conference on Physical Modeling of Transport and Dispersion, Aug. 7-10, 1990.

45-3742

FLOW RATE, VEGETATION FACTORS, SLOPES, SEWAGE

TREATMENT, WATER TREATMENT, WASTE TREATMENT, WATER FLOW

A series of experiments were conducted to measure dispersion in an overland flow system. The overland flow system consisted of three parallel grass covered areas 30.5 m long and 2.9 m wide, and sloping at 5%. Primary wastewater was applied at the upper end of the slopes and was collected at the lower end of the slope. Steady hydraulic flow was established prior to an area source of chloride tracer being applied to the upstream end of the slope. The chloride tracer concentration was measured at the outlet of the overland flow system. Data were collected during three consecutive years so that the effects of grass growth and slope maturation on dispersion could be studied. The average velocities during the dispersion measurements varied from .003 m/s to .025 m/s. Longitudinal dispersion coefficients varied from a low of .02 sq m/s to a high of 0.3 sq m/s. Phenomena which led to difficulties in relating the dispersion measurements to velocity include the continual changing growth patterns of the grass, grass harvesting patterns, and the development of erosion channels on the slope.

MP 2915

MEASUREMENT OF HEAT LOSSES FROM A BURIED HEAT DISTRIBUTION SYSTEM.

Phetteplace, G.E., Heat transfer in geophysical media, New York, American Society of Mechanical Engineers, 1991, p.47-54, 11 refs. Presented at the 28th National Heat Transfer Conference, Minneapolis, MN, July 28-31, 1991. HTD (Heat Transfer Division), Vol.172, 45-3743

HEAT TRANSFER, BUILDINGS, MILITARY FACILITIES, HEATING, HEAT PIPES, HEAT LOSS

The actual heat losses from operating heat distribution systems used to convey heat from central plants to buildings are not well known. The effect of the type of distribution system and the length of time in service on heat losses are also not known. Methods used to calculate heat losses have not been adequately verified. This paper will describe a field project at Ft. Jackson, SC, which addresses these needs. At Ft. Jackson three different types of systems have been instrumented: shallow concrete trench, steel conduit with supply and return in common conduit, and separate conduits for supply and return pipes. The heat losses from these systems have been and are being monitored using several methods. Data have been collected from these sites for over four years. The initial results will be presented in this paper.

MP 2916

DISSOLUTION OF METALS FROM SOILS AND SEDIMENTS WITH A MICROWAVE-NITRIC ACID DIGESTION TECHNIQUE.

Hewitt, A.D., Reynolds, C.M., *Atomic spectroscopy*, Sep.-Oct. 1990, 11(5), p.187-192, 26 refs. 45-3744

MICROWAVES, SOIL CHEMISTRY, METALS, SOIL POLLUTION, WASTE TREATMENT

A microwave-nitric acid digestion technique for metal extraction efficiency using an environmental reference standard sediment has been tested. Recoveries have been compared with a certified hot-plate digestion method for a standard soil. The microwave-heated acid extraction of metals from soils and sediments is faster, more routine, and less subject to technician error; yet, it does not sacrifice extraction efficiency or precision. The proposed procedure appears to be suitable for extracting Ag, As, Ba, Cd, Cu, Cr, Hg, Ni, Pb, Se, Ti, and Zn from anthropogenically contaminated soils and sediments.

MP 2917

COMPARATIVE STUDY OF ICING RATES IN THE WHITE MOUNTAINS OF NEW HAMPSHIRE.

Govoni, J.W., International Workshop on Atmospheric Icing of Structures, 5th, Tokyo, Oct. 29-31, 1990. Proceedings, [1990], 5p., 6 refs. 45-3745

MOUNTAINS, POWER LINE SUPPORTS, ICE ACCRETION, ICING RATE, TOPOGRAPHIC EFFECTS, METEOROLOGICAL FACTORS

During the three winter icing seasons from 1987-1990, meteorological data including wind speed and direction, air temperature and icing rates were measured at two mountain sites. These sites, located in the White Mountains of New Hampshire, were the summit of Cannon Mountain and a location on the west side of Mt. Washington (Cog), both at an elevation of 1230 m. This study compared icing rates and intensities from a site located at the summit of a mountain to those of a site of similar elevation located on the weather-prevalent side of a mountain. Analysis of data from the same weather system passages for both sites show a substantially higher icing rate at the mountain summit site than at the mountainside site.

MP 2918

EFFICIENCY ANALYSIS OF A STEAM HEAT DISTRIBUTION SYSTEM.

Phetteplace, G.E., International Symposium on Fluids for District Heating, Copenhagen, Apr. 10-11,

1991. Proceedings, Technical University of Denmark, 1991, p.199-213, 9 refs. 45-3746

ANALYSIS (MATHEMATICS), BUILDINGS, MILITARY FACILITIES, HEAT TRANSFER, HEATING, HEAT PIPES, COST ANALYSIS, STEAM

This paper describes an efficiency analysis for the steam heat distribution system at Hawthorne AAP. The analysis is based on the limited data available from the boiler logs maintained at the central plant. From this information, along with energy and mass balances that are constructed for the central plant data, gross measures of efficiency are obtained. A weighted average of the heating degree days for two groups of buildings connected to the system is developed as an indicator of the load on the system. Statistical analysis is used with the data from a 181-day continuous period of boiler operation to obtain estimated linear functions for the efficiency measures as they relate to the heating load. The results of the analysis show that only 43.5% of the steam input to the distribution system is used to meet the required space heating load. The results also indicate that on the average only 46.2% of the steam that leaves the plant returns as condensate. By converting to a low temperature hot water heat distribution system it is estimated that savings would exceed \$292,000 for the 181-day study period.

MP 2919

THAW WEAKENING OF PAVEMENT STRUCTURES IN SEASONAL FROST AREAS.

Janoo, V.C., Berg, R.L., *Transportation research record*, 1990, No.1286, p.217-233, 16 refs. 45-3747

SEASONAL FREEZE THAW, THAW DEPTH, THAW WEAKENING, PAVEMENTS, FREEZE THAW TESTS

Pavement structures in the northern United States, Canada, Scandinavia, and other seasonal frost areas of the world are subject to freezing in winter and thawing in spring. Most damage to pavements in seasonal frost areas occurs during the spring thaw and, to a lesser extent, during partial thaw periods in winter. To minimize damage, pavement engineers must be able to determine the structural capacity of road and airfield pavements during thawing periods. Four pavement test sections were built in the Frost Effects Research Facility at the U.S. Army Cold Regions Research and Engineering Laboratory in Hanover, NH, to study the performance of various pavement structures subjected to freeze-thaw cycling. The test sections consisted of asphalt concrete pavement over a clay subgrade, asphalt concrete over 178 mm of crushed gravel and 203 mm of clean sand on a clay subgrade, and asphalt concrete over 254 mm of crushed gravel and 127 mm of clean sand on a clay subgrade. Thermocouples were embedded throughout the pavement structure and subgrade, and the pavement structure was subjected to several freeze-thaw cycles. Deflection measurements taken during the thawing periods at four locations in each test section used a Dynatest falling-weight deflectometer (FWD) to validate existing back-calculation procedures for pavements subject to seasonal frost. Soon it became apparent that the back-calculation procedures had difficulties. Another study was initiated to determine if additional information pertaining to freeze-thaw cycling could be obtained from the FWD measurements. The results of the second study are presented.

MP 2920

PREDICTION OF DAMAGE TO FLEXIBLE PAVEMENTS IN SEASONAL FROST AREAS.

Allen, W.L., Berg, R.L., Bigl, S.R., *Transportation research record*, 1990, No.1286, p.234-247, 16 refs. 45-3748

SEASONAL FREEZE THAW, COMPUTER PROGRAMS, FATIGUE (MATERIALS), THAW WEAKENING, PAVEMENTS, FROST RESISTANCE, FROST ACTION

The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) is developing a mechanistic pavement design method for use in seasonal frost areas by the Corps of Engineers and the Air Force. The mechanistic method will employ results from a series of five computer programs that compute soil and pavement moisture and temperature conditions (FROST1), resilient modulus and Poisson's ratio (TRANSFORM), stresses and strains in the pavement system (JULEA and NELAPAV), and cumulative damage (CUMDAM). The model has been calibrated for the properties of six soils. Five fatigue equations, three based on horizontal strain at the bottom of the asphalt layer and two based on vertical strain at the top of the subgrade, are used to determine the cumulative damage for two-, three-, and four-layer pavement sections at Springfield, MO, and Rochester, MN. Although all of the equations predicted failure during the design life for each pavement section modeled, significant jumps occurred during the spring, indicating that the thaw period is crucial in the fatigue life of a pavement.

MP 2921

RIVER AND LAKE ICE CONDITIONS AS DETERMINED FROM AIRSAR IMAGERY.

Melloh, R.A., Gatto, L.W., *California Institute of Technology. Jet Propulsion Laboratory. JPL publication*, Nov. 15, 1990, No.90-56, p.37-42, 5 refs. 45-3755

ICE CONDITIONS, RIVER ICE, LAKE ICE, SYNTHETIC

APERTURE RADAR, REMOTE SENSING, AIRBORNE RADAR

Synthetic aperture radar (SAR) imagery data can provide information on types and distribution of river and lake ice needed for studying river ice processes and dynamics, monitoring ice during winter navigation, and formulating ice control strategies. Visible and IR remote sensing systems cannot provide such data, and present field methods are inadequate for characterizing ice conditions over long river reaches. The ongoing analysis of JPL's AIRSAR imagery data and concurrent ground truth of ice conditions on the Tanana River and surrounding lakes near Fairbanks, AK, in Mar. 1988, has resulted in several findings: hummocked ice covers and zones of variable ice surface roughness within them can be differentiated; C- and L-band data are more sensitive than P-band to the range of surface roughnesses encountered; smooth, level ice that is clear or contains small bubbles produces little backscatter; snow-covered river ice, whether rough or smooth, is distinguishable from snow-covered river sediments on exposed river beds and unvegetated bars; and open water leads are readily distinguished.

MP 2922

ABSORPTION COEFFICIENTS OF ICE FROM 250 TO 400 NM.

Perovich, D.K., Govoni, J.W., *Geophysical research letters*, July 1991, 18(7), p.1233-1235, 14 refs. 45-3761

ICE COVER, ICE OPTICS, LABORATORY TECHNIQUES, REMOTE SENSING

Absorption coefficients for pure bubble-free ice are a critical element in theoretical efforts to determine levels of ultraviolet radiation reaching marine biota in and under a sea ice cover. A 3-m block of ice was used to measure these coefficients from 250 to 400 nm. Absorption coefficients were found to increase from 0.092/m at 400 nm to 0.665/m at 250 nm. Values in the ultraviolet were shown to be comparable to visible results from 580 to 720 nm. This suggests that existing data on the interaction of visible light with snow and sea ice can be used as a first-order estimate of ultraviolet optical properties. (Auth.)

MP 2923

INTERPRETATION OF SYNTHETIC APERTURE RADAR IMAGERY OF SNOW-COVERED RIVER ICE.

Melloh, R.A., Gatto, L.W., U.S. Army Corps of Engineers Remote Sensing Symposium, 7th, Portland, OR, May 7-9, 1990. Proceedings, 1990, 13p., 9 refs. 45-3766

REMOTE SENSING, ICE SURVEYS, SNOW COVER EFFECT, PHOTOINTERPRETATION, SYNTHETIC APERTURE RADAR, RADAR PHOTOGRAPHY, RIVER ICE, ICE CONDITIONS

An ongoing CRREL research project is interpreting snow and ice conditions on the Tanana River near Fairbanks, AK, using airborne synthetic aperture radar (AIRSAR) imagery. The data in this report were acquired in Mar. 1988 by NASA and the Jet Propulsion Laboratory. The C-, L- and P-band images include four polarizations (HH, VV, HV and VH) and represent both wet and dry snow conditions. Ground truth data taken during the SAR overflights include snow and ice depth, stratigraphy, and surface roughness, as well as aerial video and impulse radar traces. Results to date confirm that the radar distinguishes accumulation ice covers (ice jams), smooth ice, open leads, and exposed river beds and bars. Variation in the magnitude of radar backscatter is observed along ice jams and is dependent on radar wavelength and ice jam roughness. The ability to distinguish river ice types and conditions on the images indicates good potential for the use of the data in studies of river ice processes and in engineering applications.

MP 2924

MICROWAVE-HEATED-ACID DISSOLUTION OF METALS FROM CONTAMINATED SOILS AND SEDIMENTS.

Hewitt, A.D., Reynolds, C.M., *U.S. Army Toxic and Hazardous Materials Agency (USATHAMA). Report*, 1989, CETHA-TE-TR-90055, p.463-470, 19 refs. Proceedings of the 14th Annual Army Environmental R&D Symposium, Williamsburg, VA, Nov. 14-16, 1989. 45-3765

SOIL CHEMISTRY, METALS, SOIL POLLUTION, WASTES, CHEMICAL ANALYSIS

MP 2925

AMMONIUM UPTAKE BY FIELD-GROWN ERIOPHORUM VAGINATUM ROOTS UNDER LABORATORY AND SIMULATED FIELD CONDITIONS.

Marion, G.M., Kummerow, J., *Holarctic ecology*, Feb. 1990, 13(1), p.50-55, 34 refs. 45-3767

ROOTS, ECOSYSTEMS, TUNDRA, NUTRIENT CYCLE, PLANT ECOLOGY, PLANT PHYSIOLOGY

Nitrogen (N) deficiencies in tundra ecosystems could be caused,

in part, by the kinetics of root N uptake. The objectives of this study were to quantify NH₄ uptake by field-grown excised roots of *Eriophorum vaginatum* L. under controlled NH₄ concentrations (0-250 micromoles/l) and temperatures (5-20 °C) and to evaluate this laboratory derived model as a means of estimating field NH₄ uptake. There was no consistent temperature effect on root NH₄ uptake, which suggests a relative insensitivity of *E. vaginatum* roots to short-term temperature fluctuations. The Michaelis-Menten equation parameters for NH₄ uptake were V_{max}=22.1 micromoles/h/g and K_m=191 micromoles/l. Using field NH₄ concentrations, field *E. vaginatum* root biomass data, and the Michaelis-Menten equation, an estimate was made of NH₄ uptake over a 42 day period. This estimate of NH₄ uptake accounted for 28% of the net incorporation of N into leaves and roots, which is a reasonable estimate for *E. vaginatum* which relies primarily on N retranslocation for supplying new leaves and roots. Major uncertainties in field N uptake rates, model parameterization, and site characterization preclude an accurate model validation and indicate research areas most in need of future study.

MP 2926 MAXIMUM VARIATION OF AIR/SNOW INTER-FACE TEMPERATURE.

Bates, R.E., Yen, Y.C., Gerard, S., *U.S. Army Chemical Research, Development and Engineering Center Report*, Nov. 1990, CRDEC-CR-092, p.411-422, 14 refs. Proceedings of the 14th Smoke/Obscurants Symposium, Vol.2.

45-3768

MILITARY OPERATION, ANALYSIS (MATHEMATICS), SURFACE TEMPERATURE, SNOW SURFACE, SNOW AIR INTERFACE, SNOW TEMPERATURE, SNOW HEAT FLUX, TEMPERATURE MEASUREMENT

Prediction of snow surface temperature is vital to the successful development of sensing devices and weapon systems. In this paper, a simplified mathematical analysis is made by assuming that the snow cover is dry and of uniform density. The computed results are expressed in terms of surface temperature response as a function of snow density and its effective thermal conductivity, and are compared with limited temporal field data. The results are found to be in reasonable agreement if an appropriate surface heat flux is chosen along with proper snow density and effective thermal conductivity. The same analysis is applied to a semi-infinite metallic plate. Because of its much greater thermal inertia value, the temperature response is much smaller, and this provides a considerable thermal contrast, which is essential for the development and use of the infrared sensors.

MP 2927 PORTABLE THERMAL REFERENCE FOR WINTER FIELD STUDIES.

Lacombe, J., *International Society for Optical Engineering, Proceedings*, 1990, Vol.1311, Characterization, propagation, and simulation of infrared scenes, Orlando, FL, Apr. 16-17, 19-20, 1990, p.48-54.

45-3769

MILITARY EQUIPMENT, DETECTION, SUBSURFACE INVESTIGATIONS, INFRARED PHOTOGRAPHY, SNOW COVER EFFECT, TEMPERATURE MEASUREMENT

When documenting the infrared images of targets and backgrounds it is usually necessary to place one or more sources having known surface radiances within the field-of-view of the imaging system in order to calibrate the imagery. Although a variety of commercially available thermal references (i.e., "black bodies") exist they generally are very expensive and are not well suited for operating in the field under severe winter environmental conditions. A portable low-temperature thermal reference was recently developed at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) to calibrate infrared images of mines and snow backgrounds in winter.

MP 2928 EVALUATION OF EXISTING HYPOTHESES USED IN THE MATHEMATICAL DESCRIPTION OF ICE SEGREGATION IN FREEZING SOILS.

Nakano, Y., Takeda, K., [1990], 14p., Unpublished manuscript. 13 refs. For presentation at the 5th International Colloquium on Free Boundary Problems, Montreal, June 1990.

45-3770

SOIL WATER MIGRATION, ICE LENSES, SOIL FREEZING, FREEZING FRONT, MATHEMATICAL MODELS, ICE GROWTH

The steady growth of a segregated ice layer in freezing soils was studied mathematically and experimentally under each of three distinct and representative hypotheses on the properties of the frozen fringe, chosen among many such hypotheses reported in the literature. The condition of steady growth was found to be determined by a set of two independent variables, such as the temperature gradient at the 0 °C isotherm and that in the ice layer at the interface between ice layer and the frozen fringe, regardless of models. The results of the study clearly showed that one model is consistent with experimental data while the other two models contradict them.

MP 2929

WAVEFORM ANALYSIS OF ELECTROMAGNETIC SCATTERING FOR A THREE DIMENSIONAL TUNNEL.

Moran, M.L., Greenfield, R.J., Annual International Meeting and Exposition of the Society of Exploration Geophysicists, 60th, San Francisco, Sep. 23-27, 1990. Proceedings, [1990], 4p., 9 refs.

45-3771

WAVE PROPAGATION, SUBSURFACE INVESTIGATIONS, TUNNELS, ELECTROMAGNETIC PROSPECTING

A three-dimensional numerical model simulating a cross-borehole electromagnetic survey in the presence of a cylindrical tunnel is developed and shown to compare well to field data. The model is based on an exact Green's function solution for a true vertically oriented unit electric dipole. Model simulations for tunnels filled with air, water and highly conducting material exhibit low amplitude shadow zones which extend along the entire length of the tunnel. This shadow zone is the most reliable indicator for the presence of a tunnel. Model results for air-filled tunnels in which the angle alpha, formed by a line normal to the tunnel axis and the line connecting the source and receiver is larger than 45 deg, indicate that the tunnel is effectively opaque to incident radiation. Beyond angles of alpha=45 deg arrivals in the shadow zone are dominated by energy which diffracts around the tunnel. It is also shown that moderate tunnel dips for air-filled tunnels do not appreciably affect waveforms. Comparisons of profiles in the vertical direction between air-filled and water-filled or highly conducting tunnels show that water-filled and highly conducting tunnels exhibit only minor waveform alteration as alpha increases. Water-filled tunnels also alter the latter half of the waveform.

MP 2930

PERFORMANCE OF AN EARTHQUAKE MOTION SIMULATOR FOR A SMALL GEOTECHNICAL CENTRIFUGE.

Ketcham, S.A., Ko, H.Y., Sture, S., Centrifuge 91, Rotterdam, A.A. Balkema, 1991, p.361-368, 7 refs. Proceedings of an international conference, Boulder, CO, June 13-14, 1991.

45-3772

HYDRAULIC STRUCTURES, EARTHQUAKES, ENGINEERING GEOLOGY, EMBANKMENTS, SIMULATION

An electrohydraulic servocontrolled slip table system for earthquake motion simulation in a 15 g-ton geotechnical centrifuge is in operation at the University of Colorado. The performance of the system is illustrated here by measures of the slip table system response for a specific operating condition and by results from a model embankment experiment. It is shown that reasonable simulations of specific prototype-horizontal earthquake motions can be achieved using a signal correction technique which incorporates a measure of the system frequency response.

MP 2931

INTERPRETATION OF PASSIVE AND ACTIVE MICROWAVE IMAGERY OVER SNOW-COVERED LAKES AND RIVERS NEAR FAIRBANKS, ALASKA.

Melloh, R.A., Gatto, L.W., Workshop on Applications of Remote Sensing in Hydrology, Saskatoon, Saskatchewan, Feb. 13-14, 1990. Proceedings. Edited by G.W. Kite and A. Wankiewicz, Environment Canada, 1990, p.259-278, 14 refs.

45-3808

REMOTE SENSING, SNOW COVER, ICE CONDITIONS, RADIOLOGY, ICE JAMS, MICROWAVES, LAKE ICE, RIVER ICE, SYNTHETIC APERTURE RADAR

Passive and active microwave imagery provide information about freshwater ice and snow environments needed for a better understanding of river and lake ice processes, winter stream habitats, winter water supply and ice management. The ability to image at night and through clouds is an advantage of microwave systems over shorter wavelength visible and infrared systems. Additionally, microwave imagers have a different sensitivity to ice and snow conditions and thus provide added capability to observe features that could not be detected with visible and infrared instruments. To exploit the imagery data fully, a better understanding of microwave signatures created by freshwater ice conditions is needed. An ongoing CRREL investigation interprets snow and ice conditions on lakes and rivers near Fairbanks, AK, using both passive and active microwave imagery taken in Mar. 1988 during both wet and dry snow conditions. The imagery includes that obtained with the Jet Propulsion Laboratory's Synthetic Aperture Radar (SAR) in quad-polarized (HH, VV, HV and VH) C-, L- and P-bands, and that obtained with NORDA's Ka-band Radiometric Mapping System. Ground truth data taken during overflights includes aerial video, observations of snow depth and stratigraphy, ice core descriptions and thickness measurements, and impulse radar traces. The field data and available experimental studies of microwave interactions with snow and ice are used to interpret imagery patterns. Results to date confirm that the microwave imagery distinguishes snow and ice conditions including open leads, wet overflows, ice jams, and main channels on the Tanana River, and fracture patterns and changing snow conditions on nearby lakes. The specific geophysical characteris-

tics and conditions of river and lake ice that produced the imagery patterns are being investigated.

MP 2932

ANTARCTIC SEA ICE: A HABITAT FOR THE FORAMINIFER *NEOGLOBOQUADRINA PACHYDERMA*.

Dieckmann, G.S., Spindler, M., Lange, M.A., Ackley, S.F., Eicken, H., *Journal of foraminiferal research*, Apr. 1991, 21(2), p.182-189, 35 refs. For another version see 44-3824 or 18F-42109.

45-3837

SEA ICE, MARINE BIOLOGY, MICROBIOLOGY, ICE GROWTH, BIOMASS, ANTARCTICA—WEDDELL SEA The pelagic foraminifer *Neogloboquadrina pachyderma* (Ehrenberg, 1861) occurs in new ice, congelation ice, and the underlying water column of the Weddell Sea. *N. pachyderma* is incorporated into the ice in large numbers at the time of its formation. The average number of foraminifers per liter of ice was 87 and numbers ranged between 0 and 1,075. Sea ice contained 70 times more foraminifers per unit volume than the underlying water column, and on an areal basis the sea ice cover has approximately the same number of specimens as 60 m of underlying water column. The foraminifera are usually incorporated into the ice when it is being formed dynamically and are thus subsequently associated mainly with granular ice. Many foraminifers are able to survive and grow in the ice where algal biomass in winter is high compared to the water column, perhaps indicating an overwintering strategy. Arctic sea ice, on the other hand, is practically devoid of foraminifers. These observations may have implications for paleoceanographers who use *N. pachyderma* as a tool to reconstruct past surface water conditions. (Auth.)

MP 2933

MEMBRANE FOR IN SITU OPTICAL DETECTION OF ORGANIC NITRO COMPOUNDS BASED ON FLUORESCENCE QUENCHING.

Jian, C., Seitz, W.R., *Analytica chimica acta*, 1990, Vol.237, p.265-271, 10 refs.

46-23

EXPLOSIVES, DETECTION, OPTICAL PROPERTIES, POLYMERS, GROUND WATER, WATER POLLUTION, SOIL POLLUTION, CHEMICAL ANALYSIS

Fluorescent membrane formulations for detecting organic nitro compounds by fluorescence quenching were evaluated. The most sensitive membrane is prepared by solvent casting from cyclohexanone to incorporate pyrenebutyric acid into cellulose triacetate plasticized with isodecyl diphenylphosphate. The response follows the Stern-Vollmer law for 2,4,6-trinitrotoluene (TNT) and 2,4-dinitrotoluene (DNT). The membrane also responds to hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX). For a given set of conditions, the primary factor determining sensitivity is the extent to which each nitro compound partitions into the membrane. Detection limits are ca. 2 mg/l for DNT and TNT and 10 mg/l for RDX. Nitrogen purging prior to the measurement enhances the sensitivity and eliminates interference from oxygen. The membrane is designed to be used for remote optical in situ screening of groundwater for contamination by explosives.

MP 2934

MECHANISMS CONTROLLING VEHICLE MOBILITY ON A THAWING SOIL.

Shoop, S.A., International Conference of the ISTVS, 10th, Kobe, Japan, Aug. 20-24, 1990. Proceedings, Vol.1, Hanover, NH, International Society for Terrain-Vehicle Systems, [1990], p.301-311, 6 refs.

46-42

TRACTION, THAW DEPTH, GROUND THAWING, SOIL TRAFFICABILITY

Vehicle traction and motion resistance were tested on several freeze/thaw conditions of silty sand. Mobility tests were performed using an instrumented vehicle in a large test basin where soil temperature and saturation were controlled. The work aimed to determine how soil parameters influence vehicle mobility the most. When the soil water content is above the liquid limit, motion resistance sharply increases and traction declines rapidly. At these high water contents the thawed soil has little shear resistance, and any traction or motion resistance is provided by the hard frozen layer below. As the thaw depth increases, the vehicle sinks deeper into the soil, increasing the motion resistance. At depth, the strength contributions of the frozen layer become less effective and gross traction decreases. This results in low net traction for deep wet thaws. At low water contents, traction decreases with increasing thaw depth but resistance is constant. At water contents near the liquid limit, the soil strength is at a maximum and the depth of thaw does not significantly influence vehicle mobility.

MP 2935

TRI-SERVICE WORKSHOP ON CHEMICAL OPERATIONS IN COLD WEATHER, AUG. 1988.

Birenzve, A., ed, Yurow, H.W., ed, Parker, L.V., ed, *U.S. Army Chemical Research, Development and Engineering Center. Special publication*, Jan. 1990, CRDEC-SF-019, 298p., Refs. passim. For selected

papers see 46-90 through 46-105.

46-89

CHEMICAL PROPERTIES, WASTE TREATMENT, COUNTERMEASURES, IMPURITIES, EXPLOSIVES, MILITARY OPERATION, COLD WEATHER OPERATION, POLLUTION
The first tri-service workshop on chemical operations in cold weather was held on Aug. 16-17, 1988. The meeting was attended by representatives of different military R&D organizations, the user community, the intelligence community, and the medical community. Papers presented covered the whole gamut of the chemical cold battlefield including problems associated with detection of CB agents, protection (individual and collective) against contamination, and casualty treatment.

MP 2936

OVERVIEW OF COLD REGIONS RESEARCH AND ENGINEERING LABORATORY (CRREL).
Link, L.E., Jr., *U.S. Army Chemical Research, Development and Engineering Center. Special publication*, Jan. 1990, CRDEC-SP-019, Tri-Service Workshop on Chemical Operations in Cold Weather, Aug. 1988. Edited by A. Birenzvege, H.W. Yurow, and L.V. Parker, p.13-14.

46-90

ORGANIZATIONS, LABORATORIES, RESEARCH PROJECTS, MILITARY RESEARCH

MP 2937

CHEMICAL AGENT PERSISTENCE IN COLD WEATHER.

Leggett, D.C., *U.S. Army Chemical Research, Development and Engineering Center. Special publication*, Jan. 1990, CRDEC-SP-019, Tri-Service Workshop on Chemical Operations in Cold Weather, Aug. 1988. Edited by A. Birenzvege, H.W. Yurow, and L.V. Parker, p.43-60, 10 refs.

46-94

SOLUBILITY, ENVIRONMENTAL IMPACT, DECOMPOSITION, EVAPORATION, CHEMICAL PROPERTIES, MILITARY OPERATION, COLD WEATHER OPERATION, POLLUTION, IMPURITIES

Knowledge of chemical agent persistence is necessary for adequate protection of personnel. Persistence is significantly affected both by low temperature and by physical/chemical interaction with snow or ice. Evaporation and hydrolysis appear to be the major decay mechanisms. Factors affecting evaporation can be divided into two categories, those that are independent of the substrate surface and those that depend on the type of surface. In the absence of surface effects, simple mathematical models such as the one developed by Chinn can be used to predict persistence. In case of ice and snow, however, theoretical considerations suggest that an agent evaporation model should at least take into account ice solubility in the agent. The presence of snow/ice also provides the potential for hydrolytic decomposition of the agents. Experimental work with the simulant DFP suggests that about a 2.5-fold decrease in hydrolysis rate occurs per 10 C decrease in temperature below 0 C. A total weathering model for chemical agents was derived using the data on DMMP evaporation and DFP hydrolysis.

MP 2938

SNOW-SMOKE AND SNOW-VAPOR INTERACTION.

Hogan, A.W., *U.S. Army Chemical Research, Development and Engineering Center. Special publication*, Jan. 1990, CRDEC-SP-019, Tri-Service Workshop on Chemical Operations in Cold Weather, Aug. 1988. Edited by A. Birenzvege, H.W. Yurow, and L.V. Parker, p.111-115, 3 refs.

46-98

MILITARY OPERATION, SNOWFLAKES, SNOW AIR INTERFACE, FALLING SNOW, AIR POLLUTION, SCAVENGING

MP 2939

OPERATION OF ELECTRONIC EQUIPMENT IN WINTER CONDITIONS.

Atkins, R.T., *U.S. Army Chemical Research, Development and Engineering Center. Special publication*, Jan. 1990, CRDEC-SP-019, Tri-Service Workshop on Chemical Operations in Cold Weather, Aug. 1988. Edited by A. Birenzvege, H.W. Yurow, and L.V. Parker, p.121-128, 5 refs.

46-100

MILITARY EQUIPMENT, COLD WEATHER OPERATION, ELECTRONIC EQUIPMENT

MP 2940

DECONTAMINATION OF CHEMICAL AGENTS ON A WINTER BATTLEFIELD—AN OVERVIEW.

Parker, L.V., *U.S. Army Chemical Research, Development and Engineering Center. Special publication*,

Jan. 1990, CRDEC-SP-019, Tri-Service Workshop on Chemical Operations in Cold Weather, Aug. 1988. Edited by A. Birenzvege, H.W. Yurow, and L.V. Parker, p.173-184, 22 refs.

46-101

COUNTERMEASURES, CHEMICAL PROPERTIES, ENVIRONMENTAL PROTECTION, COLD WEATHER OPERATION, MILITARY OPERATION, POLLUTION, WASTE TREATMENT

MP 2941

SURFACE EVAPORATION: EFFECT OF SUBSTRATE MATERIAL AND TEMPERATURE.

Lunardini, V.J., *U.S. Army Chemical Research, Development and Engineering Center. Special publication*, Jan. 1990, CRDEC-SP-019, Tri-Service Workshop on Chemical Operations in Cold Weather, Aug. 1988. Edited by A. Birenzvege, H.W. Yurow, and L.V. Parker, p.225-237, 18 refs.

46-104

ANALYSIS (MATHEMATICS), CHEMICAL PROPERTIES, COLD WEATHER OPERATION, MILITARY OPERATION, POLLUTION, EVAPORATION, WASTE TREATMENT

The decontamination of surfaces covered by chemical agents can be greatly accelerated by the use of a heated air stream impinging upon the surface. The actual rate of evaporation, for any agent, is a function of the thermal history of the agent. Thus, it was expected that the nature of the substrate upon which the agent is deposited could be significant. A preliminary estimate of the effect of cold climates on the process was carried out using a simple physical model of the evaporation. A thin layer of liquid and a semi-infinite substrate are initially at a constant temperature and are subjected to a convective heat transfer flux from the ambient air, also at a fixed temperature. The surface temperature of the liquid will increase until it reaches the normal boiling point. For simplicity, it is assumed that no evaporation takes place during this time. The liquid film then evaporates while its surface temperature remains at the boiling point. The analysis indicated that the substrate material and temperature will have a significant effect on the evaporation time. If the substrate is a good conductor, such as steel or aluminum, the evaporation time will greatly exceed the time needed to evaporate the same thickness from a semi-infinite layer of the substance. Also, an initial temperature of 10 F will require a significantly longer evaporation time than that for a temperature of 70 F. Predictions have been made for various thicknesses of water and HD on steel or bakelite surfaces.

MP 2942

MULTIPLE WISCONSINIAN GLACIGENIC SEQUENCES AT WEDRON, ILLINOIS.

Johnson, W.H., Hansel, A.K., *Journal of sedimentary petrology*, Jan. 1990, 60(1), p.26-41, 56 refs.

46-110

SUBGLACIAL OBSERVATIONS, MORAINES, LITHOLOGY, GLACIAL DEPOSITS, SEDIMENT TRANSPORT, STRATIGRAPHY, GLACIER OSCILLATION

MP 2943

DEVELOPMENT OF FIELD SCREENING METHODS FOR TNT AND RDX IN SOIL AND GROUND WATER.

Jenkins, T.F., Walsh, M.E., Stutz, M.H., Lang, K.T., *International Symposium on Field Screening Methods for Hazardous Wastes and Toxic Chemicals*, 2nd, Feb. 12-14, 1991, U.S. Environmental Protection Agency, 1991, p.683-686, 6 refs.

46-109

SAMPLING, CHEMICAL ANALYSIS, SOIL POLLUTION, EXPLOSIVES, GROUND WATER, WATER POLLUTION, SOIL ANALYSIS, LABORATORY TECHNIQUES

One of the most serious environmental problems facing the Army is the presence of soil contaminated with residues of high explosives at sites where the munitions were formerly manufactured, stored, used or demilitarized. TNT and RDX are the two residues most commonly encountered because these explosives were extensively produced and do not rapidly decompose. Since TNT and RDX leach through the unsaturated zone with downward percolating water, they pose an immediate problem to ground water; thus contaminated soil must be treated or isolated. Although laboratory methods for analyzing munitions residues in soil and water are now available, reliable field methods are also desirable so that zones of high contamination can be located during initial surveys and the interface between clean soil and contaminated soil identified during cleanup. In this paper, the development of such a field method is described.

MP 2944

ANALYSIS OF FROST SHIELDS USING THE FINITE ELEMENT METHOD.

Coutermarsh, B.A., Phetteplace, G.E., *International Conference on Numerical Methods in Thermal Problems*, 7th, Stanford, CA, July 8-12, 1991. *Proceedings*, Vol.7, Pt.1. Edited by R.W. Lewis et al, Swansea, UK, Pineridge Press, 1991, p.123-132, 13

refs.

46-108

MATHEMATICAL MODELS, COMPUTERIZED SIMULATION, WATER TEMPERATURE, SOIL FREEZING, FROST PROTECTION, UNDERGROUND PIPELINES, COVERING, DESIGN, HEAT TRANSFER

In this paper, a finite element (FE) program has been developed to solve two-dimensional heat transfer problems with phase change. This program has been used to assess the practicality of frost shielding techniques. The term "frost shielding" describes the practice of using rigid board insulation to protect buried water or sewer pipes within the frost zone from freezing. This allows the burial depth to be reduced, resulting in lower installation and maintenance costs.

MP 2945

ICE WHARF ENQUIRY. REPORT OF THE NSF TASK FORCE.

Mellor, M., Barthelemy, J.L., Fitzsimmons, G.J., Hae-hle, R.J., Weeks, W.F., Washington, D.C., *Division of Polar Programs, National Science Foundation*, June 1991, 18p. + Attachments 1-23 separately bound, Refs. passim. For papers included as some of the attachments, see 26-3532, 32-296, 32-1631, 38-278, 38-2176, and 44-829, or 9G-18892, 10G-19487, 13G-28590, 14G-29316, or 17F-40759.

46-170

ICE (CONSTRUCTION MATERIAL), ICE WHARVES, ICE CRACKS, ICE BREAKUP, ANTARCTICA—MCMURDO STATION

This is the report of a task force appointed by the National Science Foundation to investigate the occurrence of two major cracks which caused the ice wharf at McMurdo Station to break into three large fragments on Feb. 13, 1991. The cargo ship *Green Wave* had just been unloaded and all personnel and material were removed before the breakup. Previous ice wharves were built in 1973, 1976 and 1983, and the present one in Mar.-Sep. 1990, by pumping sea water over the surface and letting the water freeze. It is suggested that the cause of the cracks was most probably flexural failure induced by long-wave swells of about 200 m. Other suggested causes such as concentrated vertical loads from empty shipping containers, ship impact, or bending moments from ship mooring lines, do not seem to have been strong enough in this case. An initial average ice thickness of 20 ft rather than 11 ft and two layers of reinforcing cables rather than one are recommended for future ice wharves.

MP 2946

DIELECTRIC CONSTANT AND LAYER-THICKNESS INTERPRETATION OF HELICOPTER-BORNE SHORT-PULSE RADAR WAVEFORMS REFLECTED FROM WET AND DRY RIVER-ICE SHEETS.

Arcone, S.A., *IEEE transactions on geoscience and remote sensing*, Sep. 1991, 29(5), p.768-777, 19 refs.

46-211

WAVE PROPAGATION, ICE BOTTOM SURFACE, ICE WATER INTERFACE, RIVER ICE, ICE COVER THICKNESS, DIELECTRIC PROPERTIES, RADAR ECHOES, AIRBORNE RADAR, MELTING

Analysis of short-pulse radar data taken over river ice sheets in late spring reveals that radar signal penetration of an ice sheet and determination of its thickness are not necessarily prevented by the presence of surface water or internal melting. Radar data for both wet and dry ice were extracted from surveys performed from a helicopter operating at an altitude of about 2-7 m and a speed of about 5 m/s over the Connecticut River near Windsor, Vermont. The radar used a broadband wavelet of several nanoseconds duration at a center frequency of about 500 MHz. By use of plane wave theory, the dielectric constant of ice is interpreted from the amplitudes of reflections from a solid ice sheet. This verification of plane-wave interpretation and the lack of dispersion seen in wet ice bottom returns are then used to interpret data from segments of a wet ice sheet survey for both ice thickness and surface water depth. Other ice sheet segments, for which the data allow only sporadic interpretation of ice depth, are interpreted as having internal melting. It is concluded that ice thickness can be determined for surface water layers less than about 8 mm thick for the particular wavelet used, so long as the ice interfaces are not severely rough.

MP 2947

AGITATION AND FILTERABILITY OF FREEZE/THAWED SLUDGE.

Vesilind, P.A., Hung, W.Y., Martel, C.J., *Journal of cold regions engineering*, June 1991, 5(2), p.77-83, 25 refs.

46-282

VIBRATION, PARTICLE SIZE DISTRIBUTION, SLUDGES, WASTE TREATMENT, FREEZE THAW CYCLES, PERFORMANCE, WATER TREATMENT

Particle size has opposing effects on the effectiveness of freeze/thaw sludge conditioning. Small particles migrate easily and coagulate into larger particles during freezing, but small particles also cause poor sludge dewaterability. Since agitation can change particle size, the effects of agitation on sludge dewatering before

and after freeze/thaw conditioning is of practical significance. The capillary suction time (CST) device is used to measure the dewaterability of several water and wastewater treatment sludges before and after freeze/thaw. The results show that preagitation may have a detrimental effect on the dewaterability of some sludges after freeze/thaw conditioning. For other sludges such as raw primary sludges that have large initial particle size distributions, agitation prior to freeze/thaw will not be detrimental to subsequent dewatering. Postagitation clearly has a substantial deleterious effect on dewaterability, leading to the conclusion that if freeze/thaw is used for conditioning, the thawed sludge should undergo minimum agitation before dewatering. (Auth.)

MP 2948 PERFORMANCE OF AIRPORT PCC PAVEMENTS DURING SPRING THAW PERIODS.

Janoo, V.C., Berg, R.L., Tomita, H., Aircraft/pavement interaction; an integrated system. Edited by P.T. Foxworthy, New York, American Society of Civil Engineers, 1991, p.306-322, 13 refs. Proceedings of a conference, Kansas City, MO, Sep. 4-6, 1991. 46-314

SEASONAL FREEZE THAW, CONCRETES, PAVEMENTS, RUNWAYS, THAW WEAKENING
The portland cement concrete (PCC) pavements at two Wisconsin airports, central Wisconsin Airport in Mosinee, and Outagamie County Airport in Appleton, were monitored during spring thaw in 1986. To evaluate pavement performance during this period, falling weight deflections were taken. In addition, surface and subsurface temperatures were measured at selected sites at the two airports. Since the current Federal Aviation Administration PCC pavement design criterion is based on limiting the bending stresses in the concrete slab under edge loading conditions, the major portion of the evaluation was on load transfer during the spring thaw period. This paper presents the results of the field study at these two airports.

MP 2949 FIRE SEVERITY, ASH DEPOSITION, AND CLIPPING EFFECTS ON SOIL NUTRIENTS IN CHAPARRAL.

Marion, G.M., Moreno, J.M., Oechel, W.C., *Soil Science Society of America. Journal*, Jan.-Feb. 1991, 55(1), p.235-240, 22 refs. 46-316

FOREST FIRES, SOIL CHEMISTRY, NUTRIENT CYCLE
Fire may affect soil nutrient status by direct addition of nutrients and by indirectly altering the soil environment. The objective of this study was to examine how fire severity, ash deposition, and clipping affect posttreatment soil nutrient status. There were eight experimental treatments designed to examine increasing fire severity, ash (nutrient) addition independent of fire severity, clipping to study competition for nutrients per se, and untreated controls. Fire severity affected both the quality and quantity of ash. Increasing fire severity increased the concentrations of Mg and K and decreased the concentrations of NH₄-N and NO₃-N in the ash. As fire severity increased, there was an increasing recovery of ash relative to standing biomass (10-18 g/kg). Fire increased the availability of all nutrients (NH₄-N, NO₃-N, PO₄-P, Ca, Mg and K). This nutrient enhancement was largely restricted to the surface soil (0-5 cm); only soluble N appeared to increase in the subsurface soil (5-10 cm). The soil quantities of NH₄-N increased and NO₃-N decreased with increasing fire severity, suggesting either a direct addition of variable amounts of these N ions or an indirect effect on postfire nitrification rates. Clipping had no effect on enhancing soil nutrient availability. The apparent recovery of the basic cations in the water extracts of the ash samples was in the order: K > Mg > Ca; this was different from the subsequent recovery in the soil: Ca > K > Mg. It was hypothesized that the relative recovery of basic cations in the water extracts of the ash samples was controlled by the solubility of Ca, Mg, and K salts.

MP 2950 STRENGTH DEVELOPMENT OF CONCRETE CURED AT LOW TEMPERATURE.

Korhonen, C.J., Cortez, E.R., Charest, B.A., Corps of Engineers Structural Engineering Conference, Jacksonville, FL, July 8-12, 1991, Washington, D.C., Directorate of Engineering and Construction, 1991, p.1-9, 7 refs. 46-349

CONCRETE CURING, WINTER CONCRETING, CONCRETE ADMIXTURES, CONCRETE STRENGTH
Long winters, emergency repairs, or simply a tight schedule may force an engineer to look for ways to cast concrete for structural applications during cold weather. Under adverse conditions such as these, concreting has almost always entailed expensive and time-consuming methods of protecting the fresh concrete from freezing temperatures. A newer approach is the use of chemical admixtures that depress the freezing point of water and allow concrete to gain strength at temperatures that are damaging to normal concrete. This paper discusses a study of a series of chemicals that were tested for their effect on strength gain in concrete cured at various low temperatures. The results show that appreciable strength can be promoted in concrete cured at temperatures below

freezing when these chemicals are used.

MP 2951 OVERVIEW OF SMOKE AND OBSCURATION IN THE WINTER.

Green, J., Erickson, M., Redfield, R., *U.S. Army Chemical Research, Development and Engineering Center. Special publication*, Jan. 1990, CRDEC-SP-019, Tri-Service Workshop on Chemical Operations in Cold Weather, Aug. 1988. Edited by A. Birenz-vige, H.W. Yurow, and L.V. Parker, p.99-109, 7 refs. 46-97

SMOKE GENERATORS, SNOW OPTICS, VISIBILITY, ATMOSPHERIC ATTENUATION, MILITARY OPERATION, COLD WEATHER OPERATION, AIR POLLUTION

MP 2952 THAW RESPONSE OF TUSsock-SHRUB TUNDRA TO EXPERIMENTAL ALL-TERRAIN VEHICLE DISTURBANCES IN SOUTH-CENTRAL ALASKA.

Racine, C.H., Ahlstrand, G.M., *Arctic*, Mar. 1991, 44(1), p.31-37, With French summary. 12 refs. 46-382

MECHANICAL TESTS, SUBSURFACE INVESTIGATIONS, TUNDRA, LOADING, ALL TERRAIN VEHICLES, BEARING STRENGTH, GROUND THAWING, THAW DEPTH, ENVIRONMENTAL IMPACT, TERRAIN

A perennial snowbank located in the continuous permafrost zone was cored to obtain details of its internal structure and history. In spring the snowbank is up to 10 m thick and composed of deep snow accumulated during the previous winter, overlying ice developed by basal ice accretion over many years. The perennial ice exhibits a layered structure with alternating clear and milky bands, and contains randomly oriented, variably shaped bubbles. Horizons of aeolian and mudflow deposits occur at irregular intervals and correspond to periods of aggradation and thaw truncation of the snowbank. Tritium concentrations in a core from the deepest portion of the snowbank indicate that the basal 2 m of ice pre-dates 1957. Other layers of ice likely represent precipitation that fell between 1958 and 1962, between 1968 and 1976, and after 1983. Ice developed during the 1963 atmospheric tritium peak is no longer present. Energy balance measurements indicate that potential climatic warming is unlikely to eliminate the perennial portion of the snowbank unless accompanied by substantially less snow drifting at the site.

MP 2953 STATISTICAL DESCRIPTION OF THE MICROSTRUCTURE OF YOUNG SEA ICE.

Perovich, D.K., Gow, A.J., *Journal of geophysical research*, Sep. 15, 1991, 96(C9), p.16,943-16,953, 23 refs. 46-412

IMAGE PROCESSING, SALINITY, CORRELATION, RADIO-METRY, SEA ICE, YOUNG ICE, ICE MICROSTRUCTURE, ICE CRYSTAL OPTICS, MICROWAVES, ICE MODELS, STATISTICAL ANALYSIS

In order to fully exploit microwave models of sea ice, the standard ice characterization must be supplemented by a statistical description of the ice microstructure. For the strong fluctuation theory this statistical description takes the form of the mean and variance of the permittivity plus correlation lengths. In this paper, we have computed these statistics for over 50 samples of young ice, including both columnar congelation ice and desalinated bubbly ice, which were taken from different vertical depths and horizontal positions within the ice sheet and encompassed a comprehensive range of ice temperatures and brine volumes. For each of these samples, horizontal thin sections were photographed, then digitized and analyzed on a personal computer-based image processing system. Results indicate that correlation lengths correspond to the physical dimensions of the inclusions.

MP 2954 FLOW DISTRIBUTION IN MULTIPLE CHANNELS WITH PARTIAL ICE COVERAGE.

Ashton, G.D., National Conference on Hydraulic Engineering, San Diego, CA, July 30-Aug. 3, 1990. Proceedings. Edited by H.H. Chang et al, New York, NY, American Society of Civil Engineers, 1990, p.32-38, 1 ref. 46-458

ANALYSIS (MATHEMATICS), ROUGHNESS COEFFICIENT, HYDRAULICS, CHANNELS (WATERWAYS), RIVER FLOW, ICE WATER INTERFACE, RIVER ICE, ICE COVER EFFECT

MP 2955 CONCURRENT REMOTE SENSING OF ARCTIC SEA ICE FROM SUBMARINE AND AIRCRAFT.

Wadhams, P., et al, *International journal of remote sensing*, Sep. 1991, 12(9), p.1829-1840, 8 refs. For

other versions see 44-3376 and 45-563.

46-462
ACOUSTIC MEASUREMENT, SYNTHETIC APERTURE RADAR, SUBMARINES, RADIO-METRY, LASERS, ICE SURVEYS, SEA ICE, AERIAL SURVEYS, ICE SURFACE, SUBGLACIAL OBSERVATIONS, CORRELATION, CLASSIFICATIONS

In May 1987 a concurrent remote sensing study of arctic sea ice from above and below was carried out. A submarine equipped with sidescan and upward looking sonar collaborated with two remote sensing aircraft equipped with passive microwave, synthetic aperture radar (SAR), a laser profilometer and an infrared radiometer. By careful registration of the three tracks it has been possible to find relationships between ice type, ice morphology and thickness, SAR backscatter and microwave brightness temperatures. The key to the process has been the sidescan sonar's ability to identify ice type through differences in characteristic topography. Over a heavily ridged area of mainly multiyear ice there is a strong positive correlation between SAR backscatter and ice draft or elevation. It was also found that passive and active microwave complement each other in that SAR has a high contrast between open water and multiyear ice, while passive microwave has a high contrast between open water and first-year ice. (Auth. mod.)

MP 2956 ON THE STABLE GROWTH OF SEGREGATED ICE IN FREEZING SOIL UNDER NEGLIGIBLE OVERBURDEN PRESSURE.

Nakano, Y., *Advances in water resources*, Dec. 1986, 9(4), p.223-235, 10 refs. 46-470

MINERALS, ANALYSIS (MATHEMATICS), FROZEN GROUND MECHANICS, SOIL FREEZING, SOIL WATER MIGRATION, ICE GROWTH, ICE LENSES, SOIL PRESURE, FROST HEAVE

The stable growth condition of a segregated ice layer is studied by the use of the principle of mass and heat conservation. This condition evidently depends upon the properties of a thin transitional zone, which is believed to exist between the boundary of an ice layer and a 0°C isotherm. All probable models of the transitional zone are classified and the conditions for each model is derived. The effect of the small amount of soil minerals contained in an ice layer is also studied.

MP 2957 SURFACE DECOUPLING ABOVE SNOW-COVERED TERRAIN.

Hogan, A.W., Ferrick, M.G., *Electro-Optical Systems Atmospheric Effects Library/Tactical Weather Intelligence (EOSAEL/TWI) Annual Conference*, 11th, Las Cruces, NM, Nov. 27-30, 1990. Proceedings, U.S. Army Atmospheric Sciences Laboratory, 1991, p.120-131, 24 refs. 46-502

TEMPERATURE INVERSIONS, TEMPERATURE VARIATIONS, SNOW COVER EFFECT, SNOW AIR INTERFACE, SNOW TEMPERATURE, SURFACE TEMPERATURE, TERRAIN

Inversions and multiple inversions frequently decouple the boundary layer above snow-covered ground from the prevailing tropospheric flow. This decoupling is strongly evident over areas of great local relief; experiments in the Connecticut River Valley showed the surface at many elevations to be decoupled from the lower troposphere during the winter of 1989-1990. Experimental measurements of surface air temperature near the time of sunrise indicated lags of 8 C over level ground accompanying warm advection. Morning temperature differences of 10 C were found over horizontal distances of 3 km and elevation differences of 200 m. The greatest temperature differences were found on cloudless mornings, but many cloudy mornings had terrain-related temperature variations of 2 C or greater. Temperatures over frozen bodies of water differed from those of adjacent terrain, with this temperature difference related to amount of snow cover, slope of adjacent terrain, and rate of ice production on the water body. This surface decoupling can complicate operational forecasting or nowcasting of infrared temperature contrast, optical surface definition, radar ducting, glazing or riming, and the freezing of water surfaces. Some analytical techniques are described.

MP 2958 REPORT ON THE GLACIER RESEARCH WORKSHOP, FEBRUARY 5-7, 1991, EAGLE RIVER, ALASKA.

Sturm, M., Taylor, D., Benson, C.J., Nelson, G., National Park Service, 1991, 16p., 11 refs. 46-548

CLIMATIC CHANGES, GLACIER OSCILLATION, GLACIER SURVEYS, MEETINGS, RESEARCH PROJECTS, ORGANIZATIONS, MONITORS

MP 2959
TENSILE TESTING OF EIFS LAMINAS.
Flanders, S.N., Lampo, R.G., Davies, A.G., Jr., ASTM Special technical publication, STP 1116. Insulation materials: testing and application, 2nd vol-

ume. Edited by R.S. Graves and D.C. Wysocki, Philadelphia, PA, American Society for Testing and Materials, 1991, p.619-632, 2 refs.

46-582

THERMAL STRESSES, STRAIN TESTS, JOINTS (JUNCTIONS), CRACKING (FRACTURING), THERMAL INSULATION, TENSILE PROPERTIES, WALLS

Information about tensile properties of exterior insulation finish system (EIFS) laminas has been unavailable to the engineering profession. Knowledge of the tensile properties of the reinforced laminas over the exterior surface of the insulation is key to EIFS performance and establishing rules for spacing expansion and control joints for different thicknesses in different climates.

MP 2960

HISTORICAL AND RECENT DEVELOPMENTS IN THE RESEARCH OF COLD REGIONS HEAT TRANSFER—ICE IN AIR, WATER AND EARTH.

Cheng, K.C., Yen, Y.C., Freezing and melting heat transfer in engineering: selected topics on ice-water systems and welding and casting processes. Edited by K.C. Cheng and N. Seki, New York, Hemisphere Publishing Corporation, 1991, p.17-62, 465 refs.

46-601

HISTORY, BIBLIOGRAPHIES, RIVER ICE, LAKE ICE, PERMAFROST, HEAT TRANSFER, ICE FORMATION, ICING, SOIL FREEZING

A brief review of historical and recent developments of ice formation problems in air, water and earth was made covering such subjects as atmospheric and marine icings of structures, permafrost and ground freezing (frost heave), river and lake ice (frazil ice and supercooling), arctic oil and gas pipelines, and heat transfer with freezing and melting from the unified viewpoint of cold regions heat transfer. An attempt was made to review the varied technical fields involving ice formation phenomena from the common viewpoint of heat transfer, to show the scope and subjects of cold regions heat transfer engineering.

MP 2961

CONDUCTION WITH FREEZING AND THAWING.

Lunardini, V.J., Freezing and melting heat transfer in engineering: selected topics on ice-water systems and welding and casting processes. Edited by K.C. Cheng and N. Seki, New York, Hemisphere Publishing Corporation, 1991, p.65-129, 92 refs.

46-602

ANALYSIS (MATHEMATICS), STEFAN PROBLEM, PHASE TRANSFORMATIONS, HEAT TRANSFER, CONDUCTION, SOIL FREEZING, GROUND THAWING
Conduction of heat transfer with solidification is a subset of the mathematical theory called Stefan problems or moving boundary problems. The exact solutions available are examined in some detail to yield insight into useful techniques, but approximate methods tend to be more useful for practical engineering problems. The concepts involved in the heat balance integral method, the quasi-static method, and perturbation methods are noted. Graphs are presented to aid in the application of theory to practical problems, especially those dealing with soil systems. Numerical methods and problems with significant convective aspects have not been examined, nor has an attempt been made to do more than survey the literature of conduction heat transfer with phase change.

MP 2962

ONSET OF CONVECTION AND HEAT TRANSFER CHARACTERISTICS IN ICE-WATER SYSTEMS.

Yen, Y.C., Freezing and melting heat transfer in engineering: selected topics on ice-water systems and welding and casting processes. Edited by K.C. Cheng and N. Seki, New York, Hemisphere Publishing Corporation, 1991, p.261-314, 34 refs.

46-608

ICE MELTING, PHASE TRANSFORMATIONS, ANALYSIS (MATHEMATICS), DENSITY (MASS/VOLUME), CONVECTION, ICE WATER INTERFACE, HEAT TRANSFER
This review discusses the problems associated with the anomalous temperature-density relations of water. It deals with the subjects of onset of convection, the temperature structure and natural convective heat transfer and the laminar forced convective heat transfer in the water/ice system. The onset of convection in a water/ice system was found to be dependent on thermal boundary conditions, not a constant value as in the classical fluids. This system also exhibits a unique temperature distribution in the melt layer immediately after the critical Rayleigh number is exceeded, and soon after it establishes a more or less constant temperature region which expands to about two-thirds of the melt layer depth. The constant temperature is approximately 3.2°C for water layer formed from melting above, but varies for melt layers formed from below. The heat flux across the water/ice interface was found to be a weak power function and to increase linearly with temperature for melt layer formed from above and below, respectively. Both theoretical and experimental melting studies

of ice spheres, cylinders and vertical plates show a minimum heat flux at the inversion temperature ranging from 5.1 to 5.6°C. For the case of laminar forced convection melting heat transfer, the presence of an interfacial velocity reduces heat transfer in comparison with the case without phase change.

MP 2963

FRAZIL ICE.

Daly, S.F., Freezing and melting heat transfer in engineering: selected topics on ice-water systems and welding and casting processes. Edited by K.C. Cheng and N. Seki, New York, Hemisphere Publishing Corporation, 1991, p.523-544, 21 refs.

46-615

HEAT TRANSFER, ICE CRYSTAL COLLISION, NUCLEATION, ANALYSIS (MATHEMATICS), FRAZIL ICE, ICE FORMATION, ICE CRYSTAL GROWTH

A physically based quantitative model of frazil ice in natural water bodies, which describes the dynamic evolution of the frazil crystal size distribution function, is developed. The crystal number continuity equation and the heat balance for a differential volume serve as the basis for the model. The crystal growth rate and secondary nucleation rate are the major parameters that appear in these equations. Expressions for both are derived. The crystal growth rate is controlled by the heat transfer rate from the crystal to the supercooled water, which is shown to be a function of the crystal size, the fluid turbulence and the fluid properties. Secondary nucleation is assumed to be caused by collisions, which cause fragments of the crystals to shear off. These fragments become new crystals.

MP 2964

QUASI-STEADY PROBLEMS IN FREEZING SOILS: 3. ANALYSIS OF EXPERIMENTAL DATA.

Nakano, Y., Takeda, K., *Cold regions science and technology*, Aug. 1991, 19(3), p.225-243, 24 refs.

46-639

MATHEMATICAL MODELS, FREEZING FRONT, PHASE TRANSFORMATIONS, TEMPERATURE GRADIENTS, SOIL FREEZING, FROST HEAVE, ICE LENSES, ICE GROWTH, FROZEN GROUND EXPANSION, WATER PRESURE

The results of mathematical and experimental studies presented in the two earlier papers in this series (parts I and II) on the three distinct and representative models of a frozen fringe, M-1, M-2, and M-3, clearly show that the model M-1 is consistent with the experimental data while the empirical evidence against M-2 and M-3 is overwhelming. In this work the properties of the model M-1 are further examined by analyzing the experimental data in detail. It is found that the properties of a frozen fringe based on the model M-1 are consistent with the experimental data, and that the predicted steady growth condition of an ice layer is in excellent agreement with the condition found empirically.

MP 2965

SEASONAL CHANGES IN SEA ICE OPTICAL PROPERTIES DURING FALL FREEZE-UP.

Perovich, D.K., *Cold regions science and technology*, Aug. 1991, 19(3), p.261-273, 27 refs.

46-642

ICE OPTICS, SALINITY, LIGHT TRANSMISSION, PHOTOSYNTHESIS, SEA ICE, OPTICAL PROPERTIES, FREEZE-UP, ALBEDO, SNOW COVER EFFECT, RADIANCE, SEASONAL VARIATIONS

During the seasonal transition from summer to winter conditions, a sea ice cover undergoes a profound transformation. As the air temperature drops, the ice cools, the brine volume decreases, melt ponds freeze, new ice forms in areas of open water, and the surface becomes snow-covered. There is a corresponding change in the optical properties of the ice cover, with albedos increasing and transmittances decreasing. Measurements of spectral albedo, reflectances and incident irradiances were made at visible and near-infrared wavelengths (400-1100 nm) during fall freeze-up. In general, albedos increased as freeze-up progressed, with the increase being most pronounced at shorter wavelengths. The greatest temporal changes occurred in a freezing lead where, in only a few days, albedos increased from 0.1 for open water to 0.9 for snow-covered young ice. The evolution of the transmitted radiation field under the ice was estimated using a two-stream, multilayer radiative transfer model in conjunction with observations of ice morphology and thickness. Transmission decreased dramatically due to ice cooling, snowfall, and declining incident solar irradiances. Light transmission through young ice was two orders of magnitude greater than through snow-covered multiyear ice.

MP 2966

SOUNDING SEA ICE THICKNESS USING A PORTABLE ELECTROMAGNETIC INDUCTION INSTRUMENT.

Kovacs, A., Morey, R.M., International Conference on Port and Ocean Engineering under Arctic Conditions, 11th, St. John's, Sep. 24-28, 1991. Proceedings. POAC 91. Vol.1. Edited by D.B. Muggeridge, D.B. Colbourne, and H.M. Muggeridge,

St. John's, Memorial University of Newfoundland, 1991, p.332-343, 9 refs.

46-717

ICE SURVEYS, SNOW DEPTH, SEA ICE, ICE COVER THICKNESS, SOUNDING, ELECTROMAGNETIC PROSPECTING

Field trials using a man-portable Geonics Ltd. EM31 electromagnetic induction sounding instrument with a Flow Research Inc. plug-in data processing module for the remote measurement of sea ice thickness are discussed. It was found that the instrument was capable of estimating the snow plus ice thickness to within 10% of the true value for ice from about 0.7 to 3.5 m thick. Sea-water under the Arctic Ocean pack ice has a relatively uniform conductivity (2.5 +/- 0.05 S/m). Because of this, a simplified method can be used for estimating sea ice thickness using an off-the-shelf EM31 instrument. This measurement technique is also discussed.

MP 2967

WAVE INDUCED CHAOTIC MOTION OF BERG-BITS.

Hinchey, M.J., Muggeridge, D.B., Rzentkowski, G., Lever, J.H., International Conference on Port and Ocean Engineering under Arctic Conditions, 11th, St. John's, Sep. 24-28, 1991. Proceedings. POAC 91. Vol.2. Edited by D.B. Muggeridge, D.B. Colbourne, and H.M. Muggeridge, St. John's, Memorial University of Newfoundland, 1991, p.823-835, 5 refs.

46-747

MATHEMATICAL MODELS, ICEBERGS, WATER WAVES, OFFSHORE STRUCTURES, ICE SOLID INTERFACE, ICE MECHANICS

Bergy-bits in waves pose a danger to offshore oil rigs. Recently, scale models of bergy-bits were subjected to random waves in the wave tank facility at Memorial University of Newfoundland (MUN) and their motions near a model rig were recorded using a SELSPOT system. Impact statistics were generated from the data using standard procedures. In regular waves, impact behavior was found to be very sensitive to small disturbances to the berg motion, especially near its heave resonance. This is a sign of chaos. The present paper explores this phenomenon in greater detail. It uses the Liapunov characteristic exponent concept for strange attractors to theoretically explore for chaos in the wave excited motion of a spherical berg free to move in heave only. The predicted regions of chaos for the berg are found to agree qualitatively with preliminary data from a wave tank set-up.

MP 2968

NORTH AMERICAN PARTICIPATION IN THE WMO SOLID PRECIPITATION MEASUREMENT INTERCOMPARISON.

Metcalfe, J.R., Hanson, C.L., Pangburn, T., Goodison, B.E., Bates, R.E., *Western Snow Conference. Proceedings*, 1991, 59th, p.126-129, 13 refs.

46-801

MEASUREMENT, MEASURING INSTRUMENTS, PRECIPITATION GAGES, SNOWFALL, SNOW WATER EQUIVALENT

MP 2969

MICROFRACTURE AND THE COMPRESSIVE FAILURE OF POLYCRYSTALLINE ICE.

Cole, D.M., IUTAM/IAHR Symposium, St. John's, Newfoundland, 1989. Ice-structure interaction. Edited by S.J. Jones, R.F. McKenna, J. Tillotson, and I.J. Jordaan, Berlin, Springer-Verlag, 1991, p.231-249, 21 refs.

46-845

ICE CRYSTALS, ICE MICROSTRUCTURE, ICE DEFORMATION, ICE CRACKS, ICE PRESSURE, ICE STRENGTH

This paper discusses strain rate and grain size effects on the process of microcrack nucleation in freshwater polycrystalline ice. It also examines crack nucleation mechanisms that are likely to operate under conditions of practical concern. Special attention is paid to the ductile-to-brittle transition and the role of grain size in the transition region. Experimental results on granular ice having bonded end caps revealed that there was a distinct beginning and end to the crack nucleation stage prior to brittle compressive failure. Straining at a rate of .001/s generated a population of stable microcracks over a certain range of stress; after this nucleation stage, the specimen continued to sustain increased loading up to the point of failure without extension of the existing cracks or nucleation of additional cracks.

MP 2970

PROBABILISTIC DETERMINATION OF ICE-BERG COLLISION DESIGN LOADS FOR FLOATING PRODUCTION VESSELS.

Fuglem, M.K., Duthinh, D., Lever, J.H., Jordaan, I.J., IUTAM/IAHR Symposium, St. John's, Newfoundland, 1989. Ice-structure interaction. Edited by S.J. Jones, R.F. McKenna, J. Tillotson, and I.J. Jordaan, Berlin, Springer-Verlag, 1991, p.459-482,

21 refs.

46-856

IMPACT STRENGTH, DESIGN CRITERIA, STATISTICAL ANALYSIS, ICE LOADS, ICEBERGS, FLOATING STRUCTURES, ICE SOLID INTERFACE

A probabilistic method is presented for estimating global iceberg collision design loads for floating production vessels. Preliminary design loads are estimated for a concrete semi-submersible at the Terra-Nova site on the northeast part of the Grand Banks. A large number of simulated iceberg collision loads are determined using Monte Carlo techniques to choose the required input parameters (such as iceberg size and collision velocity) from estimated distributions. Using the probability distribution of these loads and the estimated frequency of iceberg collisions, design loads corresponding to probabilities of excess of .001 and .0001 per year are estimated. The results are presented as curves giving the design load as a function of the success of the operators in detecting and avoiding icebergs.

MP 2971

ICE-STRUCTURE INTERACTION DURING INDENTATION TESTS.

Sodhi, D.S., IUTAM/IAHR Symposium, St. John's, Newfoundland, 1989. Ice-structure interaction.

Edited by S.J. Jones, R.F. McKenna, J. Tillotson, and I.J. Jordaan, Berlin, Springer-Verlag, 1991, p.619-640, 17 refs.

46-863

IMPACT TESTS, PENETRATION TESTS, ICE DEFORMATION, ICE STRENGTH, ICE LOADS, ICE SOLID INTERFACE, ICE BREAKING

To study dynamic ice-structure interaction during crushing failure of ice, indentation tests were conducted by pushing a vertical, flat indenter into the edges of floating ice sheets. The indenter was supported on three load cells to measure interaction forces at the interface. The displacements of the carriage and the indenter were measured separately. These measurements provided comprehensive data on the dynamic ice-structure interaction during crushing failure of an ice sheet. Three basic modes of ice behavior were observed: creep deformation at low velocities, intermittent crushing at intermediate velocities, and continuous crushing at high velocities. Based on these measurements, a theoretical model is proposed which produces results similar to those of the experiments.

MP 2972

METHOD OF SCALING FOR SHIP-ICE MODEL TESTS.

Colbourne, D.B., Lever, J.H., IUTAM/IAHR Symposium, St. John's, Newfoundland, 1989. Ice-structure interaction. Edited by S.J. Jones, R.F. McKenna, J. Tillotson, and I.J. Jordaan, Berlin, Springer-Verlag, 1991, p.715-729, 11 refs.

46-867

ICE MODELS, TEST CHAMBERS, ANALYSIS (MATHEMATICS), ICEBREAKERS, ICE BREAKING, ICE SOLID INTERFACE, METAL ICE FRICTION

A dimensional analysis of the problem of vessels transiting level continuous ice is presented. Resistance is divided into components and each is analyzed to identify dimensionless terms relevant to the individual component. These expressions provide a framework for scaling ship-ice model test results. A workable subset of scaling requirements for a three-component division of the problem is derived from the general case. Some experimental results are presented demonstrating the utility of the method. It is shown that it may be possible to compensate for poor scaling in ice properties by scaling each component based on its own law of similitude.

MP 2973

SEA ICE RIDGING IN THE EASTERN WEDDELL SEA.

Lytle, V.I., Ackley, S.F., *Journal of geophysical research*, Oct. 15, 1991, 96(C10), p.18,411-18,416, 17 refs.

46-1034

ICE DEFORMATION, SOUNDING, STATISTICAL ANALYSIS, SEA ICE, ICE COVER THICKNESS, PRESSURE RIDGES, HEIGHT FINDING, ACOUSTIC MEASUREMENT, OCEANOGRAPHIC SURVEYS, ANTARCTICA—WEDDELL SEA

Sea ice ridge heights and spatial frequency in the eastern Weddell Sea were measured in 1986 using a ship-based acoustical sounder. Using a minimum ridge sail height of 0.75 m, a total of 933 ridges were measured along a track length of 415 km. The ridge frequency varied from 0.4 to 10.5 ridges/km. The mean height of the ridges was found to be about 1.1 m regardless of the ridge frequency. These results are compared to other ridging statistics from the Ross Sea and found to be similar. Comparison with arctic data, however, indicates that the height and frequency of the ridges are considerably less in the Weddell Sea than in the Arctic. Whereas in the Arctic the mean ridge height tends to increase with the ridge frequency, this was not the case in the Weddell Sea, where the mean ridge height remained constant irrespective of the ridge frequency. Estimates of the contribution of deformed ice to the total ice thickness are generally low, except

for a single 53 km section where the ridge frequency increased by an order of magnitude. This resulted in an increase in the equivalent mean ice thickness due to ridging from 0.04 m in the less deformed areas to 0.45 m in the highly deformed section. These values were found to be consistent with values obtained from drilled profile lines during the same cruise. (Auth. mod.)

MP 2974

IS THE STRENGTH OF SEA ICE RELATED TO ITS CHLOROPHYLL CONTENT.

Eicken, H., Ackley, S.F., Richter-Menge, J.A., Lange, M.A., *Polar biology*, Sep. 1991, 11(5), p.347-350, 18 refs.

46-1073

ICE COMPOSITION, ICE COVER STRENGTH, ICE DENSITY, SEA ICE, ALGAE, SEASONAL ABLATION, ANTARCTICA—WEDDELL SEA

Results of uniaxial compression tests are compared to porosity and chlorophyll content of granular sea-ice samples, collected in the Weddell Sea from June to Nov. of 1986. Compressive failure stresses are significantly correlated with the total porosity of the ice, but exhibit no correlation with chlorophyll concentration. It is suggested that high chlorophyll concentrations may accompany low ice strengths only because high porosities, which are responsible for low mechanical strength, can be linked to sea-ice biology. High concentrations of ice algae may be either cause or effect of high porosities (through absorption of solar radiation in the first case or due to enhanced nutrient supply and environmental space in the second case). As a cause of high porosities, ice organisms could therefore indirectly influence the spring breakup of floes and thus the course of the ablation season. (Auth.)

MP 2975

TIME CONSTANTS FOR THE EVOLUTION OF SEA SPRAY DROPLETS.

Andreas, E.L., *Tellus*, Nov. 1990, 42B(5), p.481-497, 56 refs. For another version see 44-1221.

46-1318

HEAT TRANSFER, MOISTURE TRANSFER, DROPS (LIQUIDS), MATHEMATICAL MODELS, SEA SPRAY, AIR WATER INTERACTIONS

Sea spray droplets start with the same temperature as the ocean surface from which they form. In high-latitude, polar-low conditions, they therefore cool and evaporate in a relatively cold wind and may alter the air-sea exchange of heat and moisture. This paper presents equations that model the thermal and size (moisture) evolution of a spray droplet from the time it forms until it reaches equilibrium with its environment. The time required for a droplet to reach its equilibrium radius is always about three orders of magnitude larger than the time required to reach its equilibrium temperature. The thermal exchange is thus complete before the moisture exchange even starts. Consequently, the ambient humidity has little effect on the thermal exchange rate, and the initial droplet temperature has negligible effect on the moisture exchange rate. Spray droplets with initial radii less than 10 microns reach both thermal and size equilibrium with the ambient air. Droplets with initial radii greater than 300 microns fall back into the sea before exchanging appreciable heat or moisture and thus have little impact on air-sea exchange. Future work must focus on the generation and turbulent transport of droplets with initial radii between 10 and 300 microns if we are able to understand how sea spray affects air-sea exchange.

MP 2976

INTEGRATING REMOTELY SENSED AND SPATIAL DATA INTO WATER RESOURCES MODELS.

Merry, C.J., McKim, H.L., Arnhem, Netherlands, International Association of Hydrogeologists (IAH), [1990], 8p., 10 refs. Presented at the International Symposium on Remote Sensing of Water Resources.

46-1319

WATER BALANCE, REMOTE SENSING, DATA PROCESSING, HYDROLOGY, WATER RESERVES

The U.S. Army Corps of Engineers is developing an intelligent network system that will automate the acquisition of meteorologic and hydrologic data used in water resources models. The system is being developed to collect, analyze, and display the data for use in a workstation environment. Near-real-time models will be used to control the water resources to protect the environment. As a result, spatial database management and remote sensing techniques play an integral part in the hydrologic modelling process.

MP 2977

COSMIC SPHERULES IN THE GEOLOGIC RECORD.

Taylor, S., Brownlee, D.E., *Meteoritics*, 1991, Vol.26, p.203-211, 28 refs.

46-1418

ICE SURVEYS, SPHERES, TIME FACTOR, COSMIC DUST, CLASSIFICATIONS, GEOLOGICAL SURVEYS, AGE DETERMINATION, WEATHERING, CHEMICAL COMPOSITION

MP 2978

ICE-STRUCTURE INTERACTION DURING INDENTATION TESTS.

Nakazawa, N., Sodhi, D.S., International Symposium on Okhotsk Sea and Sea Ice, 6th, Mombetsu, Hokkaido, Japan, Feb. 3-6, 1991. Abstracts, Mombetsu, Hokkaido University, Okhotsk Sea and Cold Ocean Research Association, 1991, p.107-111, 3 refs.

46-1450

IMPACT TESTS, PENETRATION TESTS, ICE BREAKING, ICE COVER STRENGTH, ICE LOADS, ICE SOLID INTERFACE, ICE PRESSURE

MP 2979

SELECTED PAPERS ON TURBULENCE IN A REFRACTIVE MEDIUM.

Andreas, E.L., ed, SPIE milestone series, Vol. MS 25, Bellingham, WA, International Society for Optical Engineering, 1990, 693p., Refs. passim. For selected papers see 42-3000 and 43-4400.

46-1481

WAVE PROPAGATION, OPTICAL PROPERTIES, REFRACTIVITY, ATMOSPHERIC ATTENUATION, ATMOSPHERIC PHYSICS, TURBULENCE, SCINTILLATION, BOUNDARY LAYER

MP 2980

APPLICATION OF LOCAL SIMILARITY METHOD TO NONSIMILAR CONDUCTION CONTROLLED FREEZING PROBLEMS.

Aziz, A., Lunardini, V.J., *International communications in heat and mass transfer*, Nov.-Dec. 1991, 18(6), p.813-822, 10 refs.

46-1584

FREEZING FRONT, ACCURACY, FREEZING, ANALYSIS (MATHEMATICS), PHASE TRANSFORMATIONS, LIQUID SOLID INTERFACES, HEAT TRANSFER

In this paper, the local method is used to solve three nonsimilar conduction controlled freezing problems. These are: (1) freezing of a semi-infinite medium with wall convection, (2) outward cylindrical freezing with constant wall temperature, and (3) freezing of a semi-infinite medium with time-dependent wall temperature. The local similarity solutions are compared to the heat balance integral, perturbation, coupled integral equation, and numerical solutions. The method is found to be accurate within a few percent.

MP 2981

PILOT-SCALE STUDIES OF SLUDGE DEWATERING IN A FREEZING BED.

Martel, C.J., Diener, C.J., *Canadian journal of civil engineering*, Aug. 1991, 18(4), p.681-689, With French summary. 14 refs. For another version see 45-3738.

46-1635

CLIMATIC FACTORS, MELTWATER, WASTE TREATMENT, SLUDGES, STRUCTURES, DESIGN, DRYING, FREEZE THAW TESTS, COLD WEATHER PERFORMANCE

In 1986, a pilot-scale sludge freezing bed was constructed at the U.S. Army Cold Regions Research and Engineering Laboratory in Hanover, NH, USA. This bed was operated for the next three years using both anaerobically and aerobically digested sludges. Results indicate that both sludges were effectively dewatered by this process. The maximum depth of sludge frozen during this study was 1.14 m. The final solid contents were 39.3% and 24.5% for anaerobically digested and aerobically digested sludges respectively. The quality of the meltwater from the bed was similar to raw wastewater. The actual depth of sludge frozen and thawed in the bed during each year of operation was very close to that predicted by design models. Operational experience demonstrated the importance of a sand layer at the bottom of the bed for adequate drainage. Also, odors developed when the meltwater was allowed to accumulate in the bed. Odors were not a problem when the meltwater was drained away as quickly as it formed. Both sludges were easily removed with a front-end loader.

MP 2982

ARCTIC RESEARCH OF THE UNITED STATES, VOL.5.

U.S. Interagency Arctic Research Policy Committee, Myers, C.E., ed, Bowen, S.L., ed, Cate, D.W., ed, Valliere, D.R., ed, Washington, D.C., Fall 1991, 78p., Refs. passim.

46-1678

LEGISLATION, INTERNATIONAL COOPERATION, MEETINGS, RESEARCH PROJECTS, ORGANIZATIONS

MP 2983

ONE-DIMENSIONAL MODEL FOR WAVE-INDUCED ICE-FLOE COLLISIONS.

Shen, H.H., Ackley, S.F., *Annals of glaciology*, 1991, Vol.15, Symposium on Ice-Ocean Dynamics and

Mechanics, Hanover, NH, Aug. 26-31, 1990. Proceedings, p.87-95, 7 refs.
46-1716

OCEAN WAVES, ICE GROWTH, ICE MODELS, MATHEMATICAL MODELS, WAVE PROPAGATION, ICE FLOES, ICE MECHANICS, DRIFT, ICE WATER INTERFACE
From observations made in the 1986 Winter Weddell Sea Project, the characteristics of ice floes and the formation process are described. The collision of ice floes under the action of a monotonic wave is quantified. The lateral motion of an ice floe caused by the wave is modeled as the sliding of an object under gravity. Drag and added mass effects are included in the model. Two floes located at different positions are shown to have a net difference in their drift (caused only by repeated wave passages). In most cases, this differential drift eventually causes floe collision. When two floes collide, a spring and dash-pot model is adopted to calculate the contact force. A one-dimensional wave passing through a one-dimensional array of disc-shaped floes is examined. Two phenomena are apparent from the analysis: waves have a herding effect that forms bands of floes with the width equal to the wavelength, and the frequency of collision is sensitive to the elastic properties of the floes and the wave amplitude. The floes stay in contact for prolonged periods, indicating the potential to freeze together and form composite floes, as was observed in the field studies. (Auth. mod.)

MP 2984

ENERGY EXCHANGES DURING INDENTATION TESTS IN FRESH-WATER ICE.

Sodhi, D.S., *Annals of glaciology*, 1991, Vol.15, Symposium on Ice-Ocean Dynamics and Mechanics, Hanover, NH, Aug. 26-31, 1990. Proceedings, p.247-253, 10 refs.

46-1740

ICE PRESSURE, OFFSHORE STRUCTURES, ICE COVER STRENGTH, VIBRATION, IMPACT TESTS, ICE SOLID INTERFACE, ICE DEFORMATION, ICE LOADS

The data from a small-scale experimental study on ice-structure interaction are used to compute the energy exchanges that take place during creep deformation and intermittent and continuous crushing of ice. The energy supplied by the carriage is partly stored in the structural spring, partly dissipated as heat in the damping mechanisms of the structure. Except for the heat dissipation, all other forms of energy were computed from the experimental data, and the heat dissipation was computed from the energy balance using the first law of thermodynamics. Plots of all forms of energy are shown in graphical form, in which their relative magnitudes, times of occurrence and interplay can be seen. The main result of this study is the thesis that intermittent crushing or ice-induced vibration takes place whenever there is an imbalance between the rates of work done by the carriage and the indenter, and that there are no vibrations when these rates of work are equal.

MP 2985

ON THE RELATIONSHIP BETWEEN LOCAL STRESSES AND STRAINS IN ARCTIC PACK ICE.

Tucker, W.B., Perovich, D.K., Hopkins, M.A., Hibler, W.D., III, *Annals of glaciology*, 1991, Vol.15, Symposium on Ice-Ocean Dynamics and Mechanics, Hanover, NH, Aug. 26-31, 1990. Proceedings, p.265-270, 15 refs.

46-1743

ICE COVER STRENGTH, ICE DEFORMATION, ICE NAVIGATION, ICE LOADS, PRESSURE RIDGES, PACK ICE, DRIFT, ICE PRESSURE, NORWAY—SPITSBERGEN

Local ice strains and *in situ* ice stresses were simultaneously measured on the Coordinated Eastern Arctic Experiment (CEAREX). The experiment took place in the fall of 1988 and was centered about an ice-strengthened ship moored to a multi-year floe in the pack ice northeast of Spitsbergen. Stress sensors were placed at four sites, two sites on each of two adjacent multi-year floes. Principal stress components and the principal stress direction were determined at each sensor. At the same time, microwave transponders capable of measuring ice deformation to accuracies of better than 1 m were positioned within 1 km of the stress sensors and provided an approximation of the local strain field. What makes this joint dataset particularly interesting is that it includes some large ridging events, including a particularly large event which terminated the experiment when the multi-year floes in the local area were broken into small fragments. A wide range of ice stresses was measured during the period. The largest compressive stresses, about 250 kPa, were measured by the near-surface sensors. Although sensors in different locations responded differently to ice movement, the large events were common to all shallow sensors.

MP 2986

NUTRIENT STATUS IN SEA ICE OF THE WEDDELL SEA DURING WINTER: EFFECTS OF SEA ICE TEXTURE AND ALGAE.

Dieckmann, G.S., Lange, M.A., Ackley, S.F., Jennings, J.C., Jr., *Polar biology*, Dec. 1991, 11(7),

p.449-456, Refs. p.455-456.

46-1745

SEA ICE, ICE COMPOSITION, BIOMASS, ALGAE, ICE SALINITY, SALT WATER, ANTARCTICA—WEDDELL SEA
Cores and brine samples from sea ice of the Weddell Sea were analyzed for nutrients (phosphate, nitrate and silicate), salinity and chlorophyll *a* during winter. Stratigraphic analyses of the cores were also carried out. Bulk nutrient concentrations in the sea ice fluctuated widely and did not correlate with salinity; they varied between zero and two or three times those measured in the water column. Differentiation into young and old sea ice, however, revealed that nutrient concentrations in the young sea ice in many cases correspond to those in surface seawater. In older ice, nutrients showed signs of increase as well as depletion or exhaustion relative to the water column. Most of the changes in the nutrient concentrations are attributed to an increase in biological activity as the seasons progress. Silicate is expected to become the first nutrient likely to limit growth of diatoms in the ice, which is ascribed to slower regeneration or dissolution of this nutrient relative to phosphate and nitrate. A consequence of silicate exhaustion may be the succession of different algal assemblages, from a diatom-dominated community to one in which autotrophic flagellates form the largest component. (Auth. mod.)

MP 2987

ADMIXTURES FOR COLD WEATHER CONCRETING.

Korhonen, C.J., *American Public Works Association. APWA reporter*, Jan. 1992, 59(1), p.24.

46-1860

CONCRETE ADMIXTURES, WINTER CONCRETING, ANTIFREEZES

MP 2988

FINITE ELEMENT TECHNIQUE FOR THREE-DIMENSIONAL FREEZE-THAW PREDICTION.

McGilvary, W.R., Albert, M.R., *International Symposium on Cold Regions Heat Transfer*, 3rd, Fairbanks, AK, June 11-14, 1991. Proceedings. Edited by J.P. Zarling and S.L. Faussett, Fairbanks, University of Alaska, 1991, p.99-116, 14 refs.

46-1815

CONDUCTION, FREEZING FRONT, GROUND THAWING, MATHEMATICAL MODELS, PHASE TRANSFORMATIONS, LIQUID SOLID INTERFACES, HEAT TRANSFER
Heat conduction with phase change characterizes many problems in cold regions heat transfer. The analysis of practical, multi-dimensional problems is made challenging because of the moving phase-change interface, the difference in thermal properties between frozen and thawed phases, mixed boundary conditions, various heat sources, and complex geometry. The finite element technique has thus far been used successfully to analyze two-dimensional problems. In the current work, O'Neill's method of simulating phase change in two dimensions is extended to three dimensions. Phase change occurs at a discrete temperature and is implemented via a Dirac delta function. For cases where the elemental volume becomes isothermal at the phase change temperature, a so-called mushy region, a variation of O'Neill's method is presented. Included in the model are typical boundary conditions and source terms that may be useful to analyze both passive and active Arctic foundations, thaw degradation around a borehole, stabilization of road embankments, or phase-change heat storage devices.

MP 2989

FINITE DIFFERENCES WITH SINGULAR HEAT CAPACITY AND STABILITY CONSIDERATIONS FOR PHASE CHANGE COMPUTATION.

O'Neill, K., *International Symposium on Cold Regions Heat Transfer*, 3rd, Fairbanks, AK, June 11-14, 1991. Proceedings. Edited by J.P. Zarling and S.L. Faussett, Fairbanks, University of Alaska, 1991, p.117-133, 25 refs.

46-1816

HEAT CAPACITY, BOUNDARY VALUE PROBLEMS, FREEZING FRONT, ANALYSIS (MATHEMATICS), PHASE TRANSFORMATIONS, HEAT TRANSFER, LIQUID SOLID INTERFACES

It has been shown in previous work with finite elements that one can account for phase change latent heat effects computationally by embedded a singularity ("delta function") in the heat capacity. Normal finite element procedures then evaluate the apparent heat capacity (AHC) exactly, and computed results have been good. In this paper it is shown that the same methodology can be generalized to include a finite difference formulation which also works well. In addition, as a first attempt at rational stability analysis of the numerical phase change problem, simple representative 1-D cases are considered in the framework of a moving boundary formulation. The analysis produces distinct and sometimes counter-intuitive stability criteria relating simultaneously to the time stepping solution and the embedded iteration system for dealing with the nonlinearity. Results are borne out in numerical tests, and may furnish stability guidance for more general moving-boundary type phase change calculation. At least in the simple test cases investigated, the AHC system outlined above is

not restricted by the stability bounds applicable to the moving boundary formulation.

MP 2990

REVIEW OF INTRINSIC THERMOPHYSICAL PROPERTIES OF SNOW, ICE, SEA ICE, AND FROST.

Yen, Y.C., Cheng, K.C., Fukusako, S., *International Symposium on Cold Regions Heat Transfer*, 3rd, Fairbanks, AK, June 11-14, 1991. Proceedings. Edited by J.P. Zarling and S.L. Faussett, Fairbanks, University of Alaska, 1991, p.187-218, 91 refs.

46-1822

HEAT TRANSFER, THERMAL CONDUCTIVITY, SPECIFIC HEAT, LATENT HEAT, ICE DENSITY, THERMAL EXPANSION, ANALYSIS (MATHEMATICS), ICE THERMAL PROPERTIES, SNOW THERMAL PROPERTIES, ICING

This paper reviews the intrinsic thermophysical properties of snow, ice, sea ice and frost. The subjects of density, thermal expansion and compressibility of ice are discussed. In addition, the absorption coefficient of ice along with the heat capacity, latent heat of fusion and thermal conductivity of snow and ice are summarized. These topics are analyzed over a wide range of temperatures and, in the case of snow and frost, the effect of density is evaluated. The contributions of vapor diffusion and radiative and free convective heat transfer across the pore space are assessed in relation to the overall effective thermal conductivity of snow and frost. Frost layer growth rate and thickness as functions of air velocity, temperature and humidity, cooling plate surface temperature and time are also discussed. Expressions representing the specific and latent heat of sea ice in terms of salinity and temperature are given, and theoretical models to predict the thermal conductivities of fresh bubbly ice and sea ice as functions of salinity, temperature and air content are also derived.

MP 2991

ON THE ONSET OF CONVECTION OF WATER NEAR 4 C.

Yen, Y.C., *International Symposium on Cold Regions Heat Transfer*, 3rd, Fairbanks, AK, June 11-14, 1991. Proceedings. Edited by J.P. Zarling and S.L. Faussett, Fairbanks, University of Alaska, 1991, p.455-470, 480, 12 refs.

46-1844

WATER STRUCTURE, HYDRODYNAMICS, TEMPERATURE EFFECTS, WATER TEMPERATURE, ANALYSIS (MATHEMATICS), HEAT TRANSFER, CONVECTION, ICE WATER INTERFACE, WATER FLOW

Natural convection heat transfer has been studied extensively, both experimentally and analytically, and the results have been well documented. However, nearly all the work reported has dealt with fluids having monotonic density-temperature relationships or with a temperature range that precludes a density inversion. Water possesses a density anomaly at about 4 C (3.98). Therefore, for either a single-phase layer containing 4 C water or a layer formed as a result of melting ice, the classical criterion of Rayleigh stability cannot be applied. This review summarizes the studies conducted since the early 1960s on the effect of this unique density inversion on the onset of convection in a number of geometrical configurations. It has been clearly demonstrated both analytically and experimentally that the critical Rayleigh number or the critical Grashof number for either a water or ice-water system is no longer a constant value, but varies with the imposed thermal and geometric conditions.

MP 2992

HEAT TRANSFER ASSOCIATED WITH CONVECTION AND VAPOR TRANSPORT IN DRY SNOW.

Albert, M.R., McGilvary, W.R., *International Symposium on Cold Regions Heat Transfer*, 3rd, Fairbanks, AK, June 11-14, 1991. Proceedings. Edited by J.P. Zarling and S.L. Faussett, Fairbanks, University of Alaska, 1991, p.481-494, 19 refs.

46-1846

CONVECTION, VAPOR TRANSFER, AIR FLOW, SNOW PERMEABILITY, MATHEMATICAL MODELS, SNOW AIR INTERFACE, SNOW HEAT FLUX, SNOW THERMAL PROPERTIES, HEAT TRANSFER

The coupled heat and mass transfer problem of air flow through snow subject to an imposed temperature gradient is investigated numerically. A new method is proposed for the theoretical prediction of vapor transport, whereby the snow is not assumed to be saturated with vapor. Results are shown to compare favorably with analytical and experimental results. For forced convection with the set of experimental conditions examined here, it is demonstrated that the heat transfer associated with vapor transport is significant in the determination of the temperature profile, but that the major effect is due to heat convected by the dry air.

MP 2993

LOCAL SIMILARITY SOLUTION FOR FREEZING IN A SEMI-INFINITE MEDIUM WITH WALL CONVECTION.

Aziz, A., Lunardini, V.J., International Symposium on Cold Regions Heat Transfer, 3rd, Fairbanks, AK, June 11-14, 1991. Proceedings. Edited by J.P. Zarling and S.L. Faussett, Fairbanks, University of Alaska, 1991, p.515-522, 11 refs.

46-1849

CONVECTION, BOUNDARY VALUE PROBLEMS, STEFAN PROBLEM, ANALYSIS (MATHEMATICS), PHASE TRANSFORMATIONS, HEAT TRANSFER, LIQUID SOLID INTERFACES, FREEZING FRONT

An instantaneous similarity solution is developed for the freezing of a semi-infinite extent of liquid initially at its freezing temperature and cooled by convection at the wall. The solution involves four parameters: pseudo similarity variable η , dimensionless time A , freezing front parameter λ , and Stefan number S . The transcendental equation relating η , S and A is solved numerically and the results are presented in graphical form. The progress of the freezing front is displayed for $S=0.1, 0.2, 0.5, 1.0, 2.0$, and 3.0 . These results are compared with the heat balance integral, perturbation, and analog solutions and found to be quite accurate. Results for the surface temperature history for $S=0.5, 1, 5$, and 10 also compare well with the corresponding heat balance integral results. The solution strategy appears to be potentially useful for other nonsimilar phase change problems.

MP 2994

WAVE ICE GROWTH IN FORCED FLOW.

Albert, M.R., San Diego, University of California, 1991, 97p., Ph.D. thesis. Refs. passim.

46-1854

TURBULENT FLOW, LAMINAR FLOW, PIPE FLOW, BOUNDARY VALUE PROBLEMS, ICE MODELS, MATHEMATICAL MODELS, ICE HEAT FLUX, ICE FORMATION, ICE GROWTH, ICE WATER INTERFACE, FLUID FLOW

The goal of this work is to develop the analysis capability for predicting irregular and wavy ice formations in forced laminar and turbulent flow, and to use that capability in initial investigations in ice formation in internal flows such as in pipes or conduits. The stability of a small-amplitude perturbation of the ice interface in pipes is investigated, using analytical solutions for heat conduction in the ice and numerical solutions for heat transfer from the fluid. The analysis shows that, for small-amplitude perturbations and wavelengths up to sixty times the pipe diameter, heat transfer effects from the flow alone cannot cause the onset of instability. However, heat transfer from the ice in the cylindrical geometry of a pipe can have a destabilizing influence on ice growth. The destabilizing influence is most likely to occur during freezing, for thick ice and long wavelengths. Numerical experiments are conducted with the fully nonlinear moving boundary model in which both smooth ice and irregular ice profiles evolve. It is shown that the introduction of a numerical perturbation into a simulation involving initially flat ice and uniform boundary and inlet conditions can lead to a step ice profile and eventual flow recirculation. The step ice profile results from the turbulent heat transfer, and serves to illustrate the importance of including turbulence calculations in the flow field.

MP 2995

INVERSION OF AIRBORNE ELECTROMAGNETIC SURVEY DATA FOR SEA-ICE KEEL SHAPE.

Liu, G.M., Kovacs, A., Becker, A., *Geophysics*, Dec. 1991, 56(12), p.1986-1991, 13 refs.

46-1890

ICE WATER INTERFACE, ANALYSIS (MATHEMATICS), SEA ICE, ICE COVER THICKNESS, SOUNDING, ELECTROMAGNETIC PROSPECTING, AERIAL SURVEYS, ICE BOTTOM SURFACE, ACCURACY

It is possible to interpret conventional airborne electromagnetic (EM) data acquired over ice-covered arctic seas to obtain values of the sea ice thickness and, where needed, the actual sea ice keel geometry. To do so, high-frequency (inductive limit) data are required that permit the assumption that the ice is virtually transparent to the EM fields while the sea water forms a perfect conductor. Practically, a 100 kHz operating frequency is needed, but data acquired at a lower frequency can be scaled to obtain the required inductive limit anomaly. The data inversion is done by linking Occam's inversion method to a rapid numerical two-dimensional forward solution for the ice keel problem. Tests on synthetic data show a possible worst-case ice thickness error of about 15%. The results of inversion tests for two sets of survey data acquired near Prudhoe Bay, AK, also indicate an accuracy of this order. While some portion of the inversion error must be ascribed to the roughness constraint and is therefore inherent in the inversion technique used, the remainder must be ascribed to the instrumentation and is probably remediable.

MP 2996

SOUNDING SEA ICE THICKNESS USING A PORTABLE ELECTROMAGNETIC INDUCTION INSTRUMENT.

Kovacs, A., Morey, R.M., *Geophysics*, Dec. 1991,

56(12), p.1992-1998, 12 refs. For another version see 46-717.

46-1891

ELECTRICAL RESISTIVITY, SEA ICE, ICE COVER THICKNESS, SOUNDING, ELECTROMAGNETIC PROSPECTING, PORTABLE EQUIPMENT, REMOTE SENSING, PERFORMANCE

Field trials using a man-portable, commercially available electromagnetic induction (EMI) sounding instrument, with a plug-in data processing module for the remote measurement of sea ice thickness, are discussed. The processing module was made to allow for the direct determination of sea ice thickness and to show the result in a numerical display. The processing module system was capable of estimating ice thickness within 10% of the true value for ice from about 0.7 to 3.5 m thick, the thickest of undeformed ice in the study area. However, since seawater under the arctic pack ice has a relatively uniform conductivity (2.55 +/- 0.05 S/m), a simplified method can be used for estimating sea ice thickness using just an EMI instrument. This technique uses only the EMI conductivity measurement, is easy to put into use, and does not rely on theoretically derived look-up tables or phasor diagrams, which may not be accurate for the conditions of the area.

MP 2997

THERMAL RESPONSE OF DOWNHILL SKIS.

Colbeck, S.C., Warren, G.C., *Journal of glaciology*, 1991, 37(126), p.228-235, 12 refs.

46-1896

SURFACE TEMPERATURE, THERMAL ANALYSIS, SKIS, ICE SOLID INTERFACE, SLIDING, PLASTICS SNOW FRICTION, HEAT FLUX, TEMPERATURE MEASUREMENT, THERMAL CONDUCTIVITY

The temperatures in downhill skis were measured with thermocouples to investigate the heat generation associated with the sliding of skis on snow. In these tests the effects on ski temperature of the ambient snow temperature, snow type, speed, load and thermal conductivity were investigated. A significant temperature rise at the base of the ski was found at the onset of motion in all runs. The temperature rise increased for heavier loads and at lower ambient temperatures. Some ski runs lasted long enough to observe a steady-state temperature at the ski base; it increased with ambient temperature. Longitudinal and transverse temperature variations occurred and were sensitive to snow hardness and skiing technique. Also investigated was heat flow through the cross-section of the ski with a finite-element model to determine the effects of ski structure on heat retention at the base. The authors found that the thermal characteristics as determined by the structure of the ski had a significant effect on the temperature at the ski base. At lower temperatures it is expected that friction will be greater in skis which have a large aluminum plate across their base. Steel edges have a lesser effect.

MP 2998

ICEBERGS.

Ackley, S.F., Encyclopedia of earth system science, Vol.2. Edited by W.A. Nierenberg, San Diego, Academic Press, 1991, p.571-582, 11 refs.

46-1946

ICEBERG TOWING, ICEBERGS, ORIGIN, DRIFT

Icebergs are the floating remnants of ice produced on the continents in glaciers, ice sheets, and ice shelves that originate as snow compressed into ice. They differ from sea ice, which also floats in the ocean in cold regions, in that sea ice is produced by the direct freezing of seawater. Icebergs are a unique part of the earth's hydrologic cycle. The cycle is initiated as oceanic evaporated moisture which is condensed, frozen, and deposited as snow precipitation on the continents and compressed into ice by a 100 m or so of overburden snow. The ice flows to the ocean in ice streams or glaciers that are driven by gravity and that densify and deform as the ice migrates (they behave as slowly moving rivers of ice). The cycle is completed by the ice breaking off into the sea as icebergs, which then melt slowly in the ocean. For the dominantly ice portion of the hydrologic cycle the time scales are typically from decades to thousands of years, compared with the annual or slightly longer time scales more typical of the water-based hydrologic cycle in lower latitudes. Icebergs in Antarctica, Greenland, Alaska, and other northern hemisphere regions are discussed in this article. (Auth.mod.)

MP 2999

SOIL WATER: LIQUID, VAPOR, AND ICE.

Black, P.B., Encyclopedia of earth system science, Vol.4. Edited by W.A. Nierenberg, San Diego, Academic Press, 1991, p.259-269, 4 refs.

46-1954

ANALYSIS (MATHEMATICS), SOIL WATER, ADSORPTION, CAPILLARITY, ICE WATER INTERFACE

MP 3000

PROCEEDINGS OF THE 48TH ANNUAL EASTERN SNOW CONFERENCE, GUELPH, ONTARIO, JUNE 5-7, 1991.

Eastern Snow Conference, Ferrick, M.G., ed, Pangburn, T., ed, 1991, 344p., Refs. passim. For individ-

ual papers see 46-1967 through 46-1998.

46-1966

SNOW COMPOSITION, SNOW WATER EQUIVALENT, RUNOFF, SNOW DEPTH, SNOWFALL, ICE COVER, SNOW SURVEYS, SNOW COVER EFFECT, SNOW COVER DISTRIBUTION, SNOWMELT

MP 3001

EFFECTS OF CRYSTAL METAMORPHOSIS ON THE ELUTION OF CHEMICAL SPECIES FROM SNOW.

Hewitt, A.D., Cragin, J.H., Colbeck, S.C., *Eastern Snow Conference. Proceedings*, 1991, 48th, p.1-10, 9 refs.

46-1967

WATER CHEMISTRY, SNOW CRYSTAL GROWTH, ION DENSITY (CONCENTRATION), SNOW IMPURITIES, CHEMICAL PROPERTIES, METAMORPHISM (SNOW), SNOW COMPOSITION, SNOWMELT

Columns of fresh snow were aged in a -20 C coldroom with an imposed thermal gradient of approximately 36 C/m for periods of one to eight weeks. Deionized distilled water was then passed through a column of this aged snow and the eluate collected in sequential aliquots for determination of H⁺, Cl⁻, NO₃⁻ and SO₄²⁻. Concentrations of these ions in the eluate show that both fractionation (higher concentrations in initial aliquots) and preferential elution (greater enrichment of SO₄²⁻ relative to Cl⁻) in melting snow are strongly influenced by snow metamorphic processes.

MP 3002

TERRAIN CLASSIFICATION OF SNOW-COVERED WATERSHEDS.

Elder, K., Davis, R.E., Bales, R.C., *Eastern Snow Conference. Proceedings*, 1991, 48th, p.39-49, 17 refs.

46-1970

SNOW WATER EQUIVALENT, SNOWMELT, RUNOFF FORECASTING, TOPOGRAPHIC EFFECTS, ALPINE LANDSCAPES, MATHEMATICAL MODELS, TERRAIN IDENTIFICATION, SNOW COVER DISTRIBUTION, WATERSHEDS, SNOW SURVEYS, TERRAIN

If the spatial distribution of snow can be estimated, it may be classified into areas, which may simplify snow melt calculations, melt water routing through the pack, and recovery of snow properties from remote sensing data. Complex topography produces spatially variable patterns of snow accumulation and ablation. The objective in this study is to develop an automated method that unambiguously divides a snow-covered watershed into terrain units that: 1) do not overlap major subcatchment divides, 2) have similar net potential solar radiation within their boundaries, and 3) have relatively uniform snow water equivalence within their boundaries. It is shown that the number of classes delineated by this method will be orders of magnitude less than the number of nodes in a digital elevation model of even a small watershed, which can be on the order of 100,000 to 1,000,000. This method is developed in an alpine watershed whose landcover features are simple; it has little vegetation or soil cover. The method is suitable to distribute point energy balance calculations over a watershed.

MP 3003

MICROWAVE PROPAGATION OVER A CHANGING SNOWCOVER.

Peck, L., *Eastern Snow Conference. Proceedings*, 1991, 48th, p.163-174, 4 refs.

46-1979

SNOW SURFACE, RADAR, WAVE PROPAGATION, SNOW COVER EFFECT, SNOW ELECTRICAL PROPERTIES, MICROWAVES

A bistatic (separate transmit and receive units) microwave (10.5 GHz) radar is in continuous operation over a 120 m range at the CRREL research facility in South Royalton, VT. The transmitting and receiving antennas, mounted at a height of 60 cm over level, grass-covered ground, have E-plane vertical polarization and a 3.5-degree single-lobe pattern. The microwave carrier is modulated at 3 kHz. The microwave field at the receiver consists of directly transmitted, reflected, and scattered radiation. Variation in the received microwave field is monitored as a voltage proportional to field strength (automatic gain control, AGC). The instantaneous AGC voltage is reported to a recording system every half hour, together with automated snow depth and site meteorology data. The AGC is seen to increase during snowfall and to decrease as the depth of the snowcover decreases. During periods of approximately constant snow depth, the AGC fluctuates with the (inferred) moisture content of the snow. For a given snow depth, the microwave field strength at the receiver is weaker, evident as a larger AGC, when the microwaves have propagated over a relatively wetter snow cover. The propagation loss over moist ground, as following snowmelt or thawing of the soil, is lower than that over dry, frozen soil.

MP 3004

MULTIDIMENSIONAL OBSERVATION OF SNOW TEMPERATURE ON WINDY DAYS.

Albert, M.R., McGilvary, W.R., *Eastern Snow Con-*

ference. *Proceedings*, 1991, 48th, p.189-200, 4 refs. 46-1981

WIND FACTORS, AIR FLOW, SNOW HEAT FLUX, SNOW AIR INTERFACE, SNOW TEMPERATURE

Three-dimensional field measurements of snow temperature in a shallow, seasonal snowpack were made during the winter of 1990-1991. The data show evidence of the thermal effects of windpumping down to depths of approximately 12 cm in a seasonal snow cover of 23 cm total depth. The air movement through the snow tends to decrease the local temperature gradient in the upper portion of the snowpack over the gradient that exists in windless conditions.

MP 3005

SHIP SUPERSTRUCTURE ICING CLIMATOLOGY OF COASTAL EASTERN NORTH AMERICA.

Ryerson, C.C., *Eastern Snow Conference. Proceedings*, 1991, 48th, p.201-211, 21 refs. 46-1982

SUPERSTRUCTURES, FRONTS (METEOROLOGY), STATISTICAL ANALYSIS, SHIP ICING, CLIMATIC FACTORS, SYNOPSIS METEOROLOGY, ICE FORECASTING

Superstructure icing occurs when bow-generated spray freezes on decks and bulkheads. Most common to smaller vessels, icing hinders deck activity, increases draft, decreases freeboard, and raises center of gravity. Forecasts of icing potential may allow vessels to avoid hazardous areas. This report develops a synoptic climatology of superstructure icing in eastern North American coastal waters from a database maintained by the Atmospheric Environment Service of Canada. Ships with 5 cm or more of accreted ice were selected from the database, providing a sample of 117 superstructure icing incidents. Eighty percent of cases occurred behind cold fronts, with a mean distance behind cold fronts of 1600 km. Mean distances of cases from the nearest closed low are about 1000 km. Ship headings during icing are typically into the true wind in low to moderate sea states, with air temperatures averaging -8 C. Synoptic patterns found in this sample of ship icing cases are similar to those of other east coast Northern Hemisphere locations investigated by the Soviets and Japanese.

MP 3006

SNOW AS AN EXPEDIENT ADSORBENT FOR HAZARDOUS WASTE SPILLS.

Martel, C.J., Nadeau, B.M., *Eastern Snow Conference. Proceedings*, 1991, 48th, p.213-220, 7 refs. 46-1983

ADSORPTION, OIL RECOVERY, SNOW PERMEABILITY, SCAVENGING, SNOW COVER EFFECT, SNOW SURFACE, OIL SPILLS, WASTE DISPOSAL

Laboratory tests indicate that snow can be an effective adsorbent for spills of insoluble hazardous waste materials. Fresh snow was most effective, followed by old snow and wet snow. The sorption ratios ranged from 0.24 g/g to 3.12 g/g depending on the type of snow and waste material. Also, a column study indicated that much of the adsorbed material drains out if it is not collected soon after it is mixed with the snow. A hypothetical spill scenario is presented that shows how snow might be used as an adsorbent in a typical spill situation.

MP 3007

HIGH LATITUDE, WEST COAST MOUNTAIN-TOP ICING.

Claffey, K.J., Ryerson, C.C., *Eastern Snow Conference. Proceedings*, 1991, 48th, p.221-232, 9 refs. 46-1984

ICING RATE, ICE ACCRETION, MOUNTAINS, ICING, ICE STORMS, ICE DETECTION

Numerous studies have characterized in-cloud mountaintop icing at North American midlatitude locations. This paper describes mountaintop icing at a high-latitude west coast location, Site Summit, near Anchorage, AK. Icing was monitored at an elevation of 1189 m with a Rosemount ice detector. Data from the 1989-90 winter season at Site Summit are compared to icing conditions at two east coast sites. Site Summit had 102 icing events during the year with an average duration of 7.5 hours per event. Peak icing intensity occurred in the late fall and early winter, with icing rates averaging 0.11 g/hr-cm of ice detector probe length and peaking at 1.06 g/hr-cm of probe length. An overview of weather conditions during icing events is also presented from measurements from nearby rawinsondes.

MP 3008

INVESTIGATION OF TEMPERATURE VARIATION OVER SNOW-COVERED GROUND.

Hogan, A.W., Ferrick, M.G., *Eastern Snow Conference. Proceedings*, 1991, 48th, p.245-254, 17 refs. 46-1986

TEMPERATURE VARIATIONS, TEMPERATURE INVERSIONS, SNOW AIR INTERFACE, SNOW COVER EFFECT, SURFACE TEMPERATURE, AIR TEMPERATURE

Fragmentary climatic data show that large mean winter temperature differences occur over short horizontal distances in northern New England. Initial winter experiments indicated that very great local variation in pre-sunrise surface air temperature occurred along the Connecticut Valley. A thin layer of air over or adjacent

to the Connecticut River was proposed as a reference plane to examine these temperature differences. Experiments showed this reference plane concept to be valid over a 10 km distance scale, but that nonuniform cloud cover often invalidated the reference plane concept on a 30 km distance scale. The influences of slope and terrain on local temperature structure are presented, showing that temperatures on small flats and in small basins differ the most from general tropospheric temperatures. The greatest local air temperature differences with respect to both time and space occur during periods of warm advection, and somewhat lesser variation occurs during cold zonal advection. The least local temperature differences occur during cold meridional advection.

MP 3009

HIGH-WIND SNOW COLLECTOR.

Govoni, J.W., Meese, D.A., *Eastern Snow Conference. Proceedings*, 1991, 48th, p.281-284, 3 refs. 46-1990

BLOWING SNOW, SNOW COMPOSITION, METEOROLOGICAL INSTRUMENTS

Pure snow samples that are free from local contaminants can best be collected on mountaintops, but the extremely high winds that typically occur there make sample collection difficult. During the winters of 1989-90 and 1990-91, snow samples were collected at the summit of Mt. Washington, NH, using a specially designed high-wind snow collector that allowed snow collection in winds as high as 80 mph (129 km/h) and temperatures as low as 0 F (-18 C). The collector consists of a Lexan "bucket" and an adjustable framework that allows the bucket to be rotated directly into the wind for increased collection efficiency.

MP 3010

SNOW, ICE AND FROZEN GROUND OBSERVATIONS IN A POND/MARSH WETLAND.

Melloh, R.A., Racine, C.H., *Eastern Snow Conference. Proceedings*, 1991, 48th, p.285-292, 8 refs. 46-1991

PONDS, SNOW COVER EFFECT, HEAT FLUX, MOISTURE TRANSFER, WETLANDS, FROST PENETRATION, ICE COVER THICKNESS

MP 3011

PRECISE WATER TEMPERATURE MEASUREMENT AT REMOTE FIELD SITES.

Clark, C., Daly, S.F., Rand, J.H., *Eastern Snow Conference. Proceedings*, 1991, 48th, p.301-306, 1 ref. 46-1993

PROBES, DATA TRANSMISSION, WATER TEMPERATURE, TEMPERATURE MEASUREMENT, THERMISTORS

An instrument developed at USACRREL to precisely measure water temperature at field sites consists of a temperature probe, connecting cabling and an interface box; it is rugged, highly accurate and easily deployable. The probes contain individually calibrated thermistors, whose resistance is determined by voltage measurements of a half-bridge circuit in the interface box. A precision 10K ohm resistor in the interface box helps assess the accuracy of the voltage measurements, and provides a means of correcting the thermistor readings. Generally, the temperature probe is connected to a Data Collection Platform (DCP) and the readings are transmitted through a Geostationary Operational Environmental Satellite (GOES) to a downlink. Such probes are installed on the St. Clair, the St. Lawrence, the Ohio, the Missouri and the Illinois rivers. They are adaptable to a variety of site conditions, and can be strapped to vertical walls or deployed horizontally through gage well connecting pipes.

MP 3012

SIMPLE MODEL OF SHOCK-WAVE ATTENUATION IN SNOW.

Johnson, J.B., *Journal of glaciology*, 1991, 37(127), p.303-312, 12 refs. 46-2155

EXPLOSION EFFECTS, SNOW MECHANICS, MATHEMATICAL MODELS, SNOW COVER EFFECT, SNOW COMPACTION, SHOCK WAVES, WAVE PROPAGATION, ATTENUATION

A simple momentum model, assuming that snow compacts along a prescribed pressure-density curve, is used to calculate the pressure attenuation of shock waves in snow. Four shock-loading situations are examined: instantaneously applied pressure impulses for one-dimensional, cylindrical and spherical shock-wave geometries, and a one-dimensional pressure impulse of finite duration. Calculations show that for an instantaneously applied impulse the pressure attenuation for one-dimensional, cylindrical and spherical shock waves is determined by the pressure density compaction curve of snow. The shock-wave pressure in snow for a finite-duration pressure impulse is determined by the pressure impulse versus time profile during the time interval of the impulse. After the pressure impulse ends, shock-wave pressure attenuation is the same as for an instantaneously applied pressure impulse containing the same total momentum. Pressure attenuation near a shock-wave source, where the duration of the shock wave is relatively short, is greater than for a shock wave farther from a source where the shock wave has a relatively long duration. Shock-wave attenuation in snow can be delayed or reduced by increasing the duration of a finite-duration pressure impulse. A sufficiently long-duration impulse may result in no shock-wave pressure attenuation in a shallow snow cover.

tion in a shallow snow cover.

MP 3013

NON-CLIMATIC CONTROL OF GLACIER-TERMINUS FLUCTUATIONS IN THE WRANGELL AND CHUGACH MOUNTAINS, ALASKA, U.S.A.

Sturm, M., Hall, D.K., Benson, C.S., Field, W.O., *Journal of glaciology*, 1991, 37(127), p.348-356, 49 refs. 46-2161

RUNOFF, PERIODIC VARIATIONS, GLACIER OSCILLATION, GLACIER TONGUES, GLACIER SURVEYS, GLACIER FLOW, VOLCANOES, TIDAL CURRENTS, MELT-WATER, UNITED STATES—ALASKA—WRANGELL MOUNTAINS

Fluctuations of glacier termini were studied in two regions in Alaska. In the Wrangell Mountains, 15 glaciers on Mount Wrangell, an active volcano, have been monitored over the past 30 years by surveying, photogrammetry and satellite. Results, which are consistent between different methods of measurement, indicate that the termini of most glaciers were stationary or retreating slightly. The terminus fluctuations of six tide-water and near-tide-water glaciers in College Fjord, Prince William Sound, have also been monitored since 1931 by surveying, photogrammetry and, most recently, by satellite imagery. Harvard Glacier, a 40 km long tide-water glacier, has been advancing at an average rate of nearly 20 m/yr since 1931, while the adjacent Yale Glacier has retreated at approximately 50 m/yr during the same period though, for short periods, both of these rates have been much higher. The striking contrast between the terminus behavior of Yale and Harvard Glaciers, which parallel each other in the same fjord, and are derived from the same snowfield, supports the hypothesis that their terminus behavior is largely the result of dynamic controls rather than changes in climate.

MP 3014

GLACIOLOGY AND ICING ON STRUCTURES.

Itagaki, K., International Workshop on Atmospheric Icing of Structures, 5th, Tokyo, Oct. 29-Nov. 1, 1990. IWAIS '90, Tokyo, 1990, p.A0/2/1-A0/2/6, 12 refs. 46-2194

ICE SOLID INTERFACE, SNOW CRYSTALS, SNOW REMOVAL, ICING, ICE ACCRETION, ICE ADHESION

Various aspects of the problems involved in atmospheric icing and ice adhesion are discussed. In this paper examples are given of hidden and unexpected mechanisms that may play an important role in ice adhesion.

MP 3015

MEASUREMENT OF RELATIVE HUMIDITY IN CLOUDS.

Itagaki, K., Lemieux, G.E., International Workshop on Atmospheric Icing of Structures, 5th, Tokyo, Oct. 29-Nov. 1, 1990. IWAIS '90, Tokyo, 1990, p.A1/1/1-A1/1/4, 5 refs. 46-2196

CLOUD PHYSICS, ICING, DEW POINT, HYGROMETERS, HUMIDITY, CLOUD DROPLETS

Attempts were made to determine if relative humidity (RH) between cloud droplets may be below water saturation when extensive ice particles are present. RH and temperature measurements behind a cylindrical shield were compared with in-stream measurements. Dew point measurements under certain conditions were more than 1 C lower behind the shield than in the stream, which indicates that RH is 10% below the water saturation at that temperature.

MP 3016

AERODYNAMIC PROPERTIES OF NATURAL RIME ICE SAMPLES.

Jones, K.F., Govoni, J.W., International Workshop on Atmospheric Icing of Structures, 5th, Tokyo, Oct. 29-Nov. 1, 1990. IWAIS '90, Tokyo, 1990, p.A5/1/1-A5/1/6, 10 refs. 46-2221

ICE ACCRETION, ICE SURFACE, SURFACE ROUGHNESS, ICING, ICE LOADS, WIND PRESSURE, ICE AIR INTERFACE

Natural rime ice samples were collected on Mt. Washington on rods placed at the midsection of a diagonally oriented taut cable. Two rod samples were collected simultaneously on parallel cables. One of each pair was tested in the refrigerated wind tunnel at the University of Quebec at Chicoutimi to measure the lift and drag on the sample at different wind speeds. The second sample in the pair was used to determine the ice properties associated with the measured lift and drag. It was cut into slices whose mass and thickness were measured. The slices were photographed under crossed polarizers on a 1 cm grid, and the photographs were analyzed using a PC-based image processor to obtain the cross-sectional area and the rime surface topography. From these data the average sample density was determined and the surface roughness was characterized. The relationships among the icing conditions, ice density, roughness and wind loading were investigated.

MP 3017

UNIVERSAL FLYING PARTICLE CAMERA.

Itagaki, K., Ryerson, C.C., International Workshop on Atmospheric Icing of Structures, 5th, Tokyo, Oct. 29-Nov. 1, 1990. IWAIS '90, Tokyo, 1990, p.B2/1/1-B2/1/4.

46-2240

PHOTOGRAPHIC EQUIPMENT, PARTICLE SIZE DISTRIBUTION, MEASURING INSTRUMENTS, SEA SPRAY, METEOROLOGICAL INSTRUMENTS

A simple system for optically capturing airborne precipitation was developed using off-the-shelf components: a video camera, a Strobe-Tac strobe light system and a video recorder. The system was mainly designed to capture sea spray on board a ship, and thus was weather-tight and included defrosters, washers, and wipers. Two inclinometers were included to indicate optically the ship's rolling and pitching on image frames.

MP 3018

SEA SPRAY ICING RATES. I. INTERMITTENT SEA SPRAY.

Itagaki, K., International Workshop on Atmospheric Icing of Structures, 5th, Tokyo, Oct. 29-Nov. 1, 1990. IWAIS '90, Tokyo, 1990, p.B2/3/1-B2/3/7, 3 refs.

46-2241

ICING RATE, COMPUTER PROGRAMS, SEA SPRAY, SHIP ICING

The icing rate by intermittent sea spray was studied using a computer model based on heat removal and water supply balanced with heat supply and water drainage. Three icing regimes, water supply controlled, mixed and melting, were identified. The maximum icing rate appeared at the lower side of water supply under the assumed conditions. Excessive water supply tended to reduce icing rate.

MP 3019

SEA SPRAY ICING RATES. II. CONTINUOUS SEA SPRAY.

Itagaki, K., International Workshop on Atmospheric Icing of Structures, 5th, Tokyo, Oct. 29-Nov. 1, 1990. IWAIS '90, Tokyo, 1990, p.B2/4/1-B2/4/8, 9 refs.

46-2242

ICING RATE, COMPUTER PROGRAMS, SEA SPRAY, SHIP ICING

The rate of icing caused by continuous sea spray was examined using a model based on supply and balance of heat and water. The results were compared with on-board ship icing observations. At lower air temperature, the model could predict the rate of icing reasonably well, but at the higher temperatures heat removal by simple convective heat transfer was insufficient.

MP 3020

RIVER ICING MOUNDS: A WINTER WATER SOURCE ON THE EASTERN NORTH SLOPE OF ALASKA.

Chachco, E.F., Jr., Collins, C.M., Delaney, A.J., Arcone, S.A., *Environment Canada. National Hydrology Research Institute. NHRI symposium*, 1991, No.6, Northern hydrology: selected perspectives. Edited by T.D. Prowse and C.S.L. Ommannney, p.33-45, 16 refs.

46-2329

ICE COVER THICKNESS, ICE SURVEYS, UNFROZEN WATER CONTENT, WATER RESERVES, AIRBORNE RADAR, NALEDs, FROST MOUNDS, WATER SUPPLY, RIVER ICE, UNITED STATES—ALASKA—NORTH SLOPE The icing mounds on two eastern North Slope rivers, the Sadlerochit and Hulahlula, were investigated in Apr. 1989. Approximately 100 mounds were surveyed on each river, representing about half the total number observed. The surveys were conducted using an airborne short-pulse radar system, from which water-bearing mounds could be estimated. The distribution of icing mounds was measured on a 50- to 70 km reach of each river, extending from the coast to the Sadlerochit Mountains. The ice thickness of water-bearing mounds was generally greater than 1.5 m, while icing mounds with an ice thickness of less than 1.3 m were generally dry. All mounds exceeding a height of 1.25 m over the surrounding ice surface were found to contain water.

MP 3021

INTERACTIVE MODELLING OF COLD REGIONS WATERSHEDS WITH SSARR.

Cassell, E.A., Pangburn, T., *Environment Canada. National Hydrology Research Institute. NHRI symposium*, 1991, No.6, Northern hydrology: selected perspectives. Edited by T.D. Prowse and C.S.L. Ommannney, p.363-377, 18 refs.

46-2352

MODELS, HYDROLOGY, DATA PROCESSING, WATERSHEDS, SNOWMELT, STREAM FLOW, RUNOFF FORECASTING

Until recently, capabilities of hydrological models to account for

the effect of cold regions processes on run-off forecasting have been limited by the difficulty of data acquisition and the absence of modelling environments that have convenient process-level based interactive features. The work reviewed here describes results from research on modifications that have enhanced the Streamflow Synthesis and Reservoir Regulation (SSARR) model's ability to account for cold regions effects. These investigations have led to the development of a systems dynamic model version of SSARR. This new model, SSARR-DS, provides an extremely user-friendly environment that offers convenient data input and constructive interactive features.

MP 3022

SUMMARY REPORT ON LOW TEMPERATURE AND THERMAL FATIGUE CRACKING.

Vinson, T.S., Janoo, V.C., Haas, R.C.G., *National Research Council. Strategic Highway Research Program, Washington, D.C. Report*, June 1989, SHRP-A/IR-90-001, 83p., 68 refs.

46-2606

LOW TEMPERATURE TESTS, COLD STRESS, THERMAL STRESSES, CRACKING (FRACTURING), FATIGUE (MATERIALS), BITUMINOUS CONCRETES, CONCRETE PAVEMENTS, CONCRETE FREEZING, CONCRETE STRENGTH

Cracking of asphalt concrete pavements owing to cold temperatures or temperature cycling can occur in many regions of the United States. Cracking that results from cold temperatures generally is referred to as low temperature cracking; cracking that results from thermal cycling generally is referred to as thermal fatigue cracking. Thermal cracks permit the ingress of water, which may result in a depression at the crack because of the pumping of support materials. During the winter months, deicing solutions can enter the cracks and cause localized thawing of the base and a depression at the crack. Water entering the crack also may freeze, resulting in the formation of an ice lens, which can produce upward lipping at the crack edge. All of these effects result in poor ride quality and reduction of pavement life. Four test systems/methods warrant further consideration in a laboratory test program, as follows: Direct Tension-Constant Rate of Extension test; Thermal Stress Restrained Specimen test; C*-Line Integral test and Coefficient of Thermal Expansion and Contraction test. A test program is identified which should be conducted to provide a preliminary evaluation of the availability of selected test systems/methods (1) for standardization, and (2) to provide input parameters to mechanistic models for low temperature and thermal fatigue cracking.

MP 3023

WAVE-INDUCED ICEBERG MOTION.

Lever, J.H., Klein, K., Mitchell, D., Diemand, D., *Cold regions science and technology*, Nov. 1991, 20(1), p.11-23, 16 refs.

46-2619

DATA PROCESSING, DESIGN CRITERIA, ICEBERGS, HYDRODYNAMICS, WATER WAVES, ICE WATER INTER-FACE, DRIFT, VELOCITY MEASUREMENT, STABILITY This paper describes the results of a three-year field study to measure the wave-induced motion of icebergs in order to examine how closely iceberg velocities, derived using wave-tank tests, reflect those of irregularly shaped full-scale icebergs. Self-contained motion-monitoring packages were deployed on icebergs in the Labrador Sea and on the Grand Banks, from which 19 data sets of wave-induced iceberg motion were obtained. These are the only available data describing the wave-induced motion of full-scale icebergs in six degrees-of-freedom. For comparison with laboratory results, computed normalized significant surge and heave iceberg velocities were computed and plotted against normalized peak wavelength. This demonstrated that velocities based on wave-tank study of four regularly shaped model icebergs do reflect the range of variation in iceberg motion attributable to random shape. The authors conclude that iceberg significant velocities are random quantities for a given size iceberg in a given sea state, and that a gamma probability density, fitted to wave-tank results, is suitable for describing their variations.

MP 3024

THERMAL CONDUCTIVITY MEASUREMENTS OF DEPTH HOAR.

Sturm, M., Johnson, J.B., *Journal of geophysical research*, Feb. 10, 1992, 97(B2), p.2129-2139, 52 refs.

46-2627

PROBES, TEMPERATURE EFFECTS, SNOW PHYSICS, DEPTH HOAR, SNOW THERMAL PROPERTIES, THERMAL CONDUCTIVITY, METAMORPHISM (SNOW), VAPOR DIFFUSION, SNOW COVER STRUCTURE, TEMPERATURE MEASUREMENT

The effective thermal conductivity of snow (k_{eff}), which includes latent heat transfer due to vapor diffusion, was measured during three winters in Fairbanks, AK. In 1986-1987, k_{eff} of several layers of snow was monitored in detail as the snow metamorphosed into depth hoar. Measurements were made using a needle probe with an estimated accuracy of $\pm 8\%$; k_{eff} was found to decrease and then increase as the snow passed from new snow through several distinct stages of depth hoar. For depth

hoar, k_{eff} ranged from 0.026 to 0.105, with an average value of 0.063 W/m/K. This is one half to one fourth the value suggested by most studies for snow of similar density. For depth hoar of a given type, k_{eff} can be represented as a linear function of temperature between 0 and -20°C but requires a nonlinear function for the range from 0 to -196°C. At -196°C the thermal conductivity of depth hoar approached that of still air, suggesting that conduction through the ice skeleton of the snow was limited and that the increase in k_{eff} at temperature near 0°C is the result of the strong temperature dependence of water vapor density. This conclusion is consistent with the nature of the ice bonds in depth hoar, which are thin and relatively few in number.

MP 3025

METEOROLOGICAL TRANSPORT OF CONTINENTAL SOOT TO ANTARCTICA.

Murphey, B.B., Hogan, A.W., *Geophysical research letters*, Jan. 3, 1992, 19(1), p.33-36, 23 refs.

46-2629

AEROSOLS, ATMOSPHERIC CIRCULATION, ATMOSPHERIC COMPOSITION, AIR POLLUTION, ANTARCTICA—ROSS ISLAND

An impactor/concentrator/microdensitometer (ICM) instrument system has been constructed and calibrated. This system is sufficiently sensitive to measure the black (carbon soot) component of antarctic aerosol with a sampling time of four hours. The impactor concentrator was exposed to antarctic air at Ross I. in Sep. 1987. Microdensitometer analysis of the collected specimens indicates that the maximum black aerosol concentration was observed concurrently with the arrival of the warmest air accompanying a cyclonic storm. This is similar to the concurrence of continental radon and lead isotopes with warm advection, measured on the antarctic coast in 1986. It is possible that continental soot can be transported to the antarctic coast several times each year by this mechanism. (Auth.)

MP 3026

INTERPRETING UNCONFINED UNFROZEN WATER CONTENT.

Black, P.B., International Symposium on Ground Freezing, 6th, Beijing, Sep. 10-12, 1991. Proceedings. Ground freezing 91. Vol.1. Edited by X. Yu and C.S. Wang, Rotterdam, A.A. Balkema, 1991, p.3-6, 6 refs.

46-2733

SOIL WATER MIGRATION, SOIL PRESSURE, SOIL FREEZING, FROZEN GROUND THERMODYNAMICS, UNFROZEN WATER CONTENT

Unfrozen water content measurements are usually obtained from unfrozen specimens exposed to the atmosphere. These data are usually presented as a simple function of temperature, which presents technical difficulties in interpreting the data. These problems are relaxed if the unfrozen water content is expressed as a function of the pressure difference between the water and ice phases as given by expressions for surface tension and phase equilibrium. This interpretation is analogous to that used to describe the characteristics of ice-free soil water, so that expressions commonly used for those systems are applicable in modeling unfrozen water content.

MP 3027

TRANSPORT OF WATER THROUGH FROZEN SOILS.

Nakano, Y., International Symposium on Ground Freezing, 6th, Beijing, Sep. 10-12, 1991. Proceedings. Ground freezing 91. Vol.1. Edited by X. Yu and C.S. Wang, Rotterdam, A.A. Balkema, 1991, p.65-70, 31 refs.

46-2742

UNFROZEN WATER CONTENT, TEMPERATURE GRADIENTS, WATER TRANSPORT, WATER PRESSURE, MATHEMATICAL MODELS, SOIL WATER MIGRATION, SOIL FREEZING, FROZEN GROUND THERMODYNAMICS

A popular hypothesis among researchers on the mechanism of water transport through frozen soils is that the flow of water under non-isothermal conditions is induced by a gradient of unfrozen water pressure that develops in response to a temperature gradient. Recent results of experimental and mathematical studies have revealed two major and independent driving forces of water: the gradients of temperature and water content in unsaturated frozen soils, and the gradients of temperature and unfrozen water pressure in saturated frozen soils. These recent results cast serious doubt upon the validity of the popular hypothesis.

MP 3028

STRENGTH OF FROZEN SOIL UNDER A COMBINED STRESS STATE.

Fish, A.M., International Symposium on Ground Freezing, 6th, Beijing, Sep. 10-12, 1991. Proceedings. Ground freezing 91. Vol.1. Edited by X. Yu and C.S. Wang, Rotterdam, A.A. Balkema, 1991, p.135-145, 31 refs.

46-2753

SHEAR STRESS, STRAIN TESTS, ANALYSIS (MATHEMATICS), FROZEN GROUND MECHANICS, FROZEN

GROUND STRENGTH, SOIL CREEP, FROZEN GROUND COMPRESSION

New parabolic yield and creep strength criteria have been developed for frozen soil (ice) under a combined stress state. The criteria take into account that the local melting of ice causes the shear strength of frozen soil to reach a maximum at a certain level of the mean normal stress, considered in the paper to be a frozen soil mechanical parameter. At low stress levels the criteria transform into the von Mises-Drucker-Prager or Mohr-Coulomb yield criteria and into the von Mises or Tresca criteria for frictionless materials. It is shown that the failure surface in the principal stress space forms a paraboloid, the shape of which depends upon the ratio of the cohesion and the friction angle on the octahedral plane and their change with time. The criteria have been verified using test data for long-term strength under six different loading regimes (uniaxial compression and tension, pure shear and triaxial compression at various mean stresses) of Kellovian silt at -10 °C. It was found that the shape of the normalized curve of the long-term strength and its parameters can be considered to be independent of the loading regime, and thus all the above test data can be superimposed on this curve.

MP 3029
STRESS MEASUREMENTS IN DRIFTING PACK ICE.

Tucker, W.B., Perovich, D.K., *Cold regions science and technology*, Feb. 1992, 20(2), p.119-139, 28 refs. 46-2803

MEASUREMENT, TEMPERATURE EFFECTS, SEA ICE, PACK ICE, THERMAL STRESSES, STRESS CONCENTRATION, ICE PRESSURE, ICE COVER STRENGTH, ICE DEFORMATION

Accurate measurements of *in-situ* pack ice forces are necessary to improve ice forecasting models and to estimate loads on offshore structures. Two months of *in-situ* ice stress measurements were obtained in the pack ice of the eastern Arctic during the fall of 1988. Sensors were placed to examine both the horizontal and vertical distributions of ice stresses in multiyear ice. Stresses in the multiyear ice 200 m from the edge of the floe reached 150 kPa during extreme deformation events. Within a few meters of the edge and in adjacent first-year ice, they exceeded 350 kPa on several occasions (400 kPa in one instance) during local ice failure events. Thermally induced stresses at shallow depths in the multiyear ice were caused by rapid temperature changes, and could be nearly as large as stresses observed during deformation. The vertical distribution of stresses varied with the type of deformation event, but the largest values were always observed in the upper half of the ice sheet. Stresses due to deformation were rapidly attenuated away from the edge of the floe. Near the edge, however, recorded stresses agreed well with those observed in the adjacent first-year ice. These two locations also experienced twice daily oscillations of about 50 kPa which are apparently tidal or inertially induced.

MP 3030
LONGITUDINAL FLOATING STRUCTURES—NEW CONCEPTS IN RIVER ICE CONTROL.

Calkins, D.J., *Canadian journal of civil engineering*, Dec. 1991, 18(6), p.933-939, With French summary. 14 refs. 46-2851

ICE COVER THICKNESS, FLOOD CONTROL, DESIGN, RIVER ICE, ICE JAMS, ICE PREVENTION, ICE CONTROL, FLOATING STRUCTURES, HYDRAULIC STRUCTURES

Ice control structures placed in the streamwise direction of a river were analyzed to determine the effectiveness in reducing ice jam thickness. The theory describing the thickness for "wide" river ice jams was modified to analyze these longitudinal types, providing the computational verification that ice jam thicknesses could be reduced where the mode of ice cover thickening is internal collapse. These longitudinal structures appear to provide a new tool for modifying the river ice regime at freeze-up and possibly at breakup. By decreasing the ice jam thickness, which leads to lower stages, the structures have the potential for decreasing ice jam flood levels. The structures' ability to function is independent of the flow velocity, and these structures should perform in rivers with velocities greater than the usual limitation of roughly 1 m/s associated with conventional cross-channel ice booms. Other possible applications include controlling ice movement at outlets from lakes, enhancing river ice cover progression, or even restraining the ice cover at breakup. A U.S. patent application has been filed jointly by the author and U.S. Army Corps of Engineers.

MP 3031
FREEZE-THAW SLUDGE CONDITIONING AND DOUBLE LAYER COMPRESSION.

Vesilind, P.A., Wallinmaa, S., Martel, C.J., *Canadian journal of civil engineering*, Dec. 1991, 18(6), p.1078-1083, With French summary. 11 refs. 46-2852

COALESCENCE, FREEZE DRYING, SLUDGES, WASTE TREATMENT, FREEZE THAW CYCLES, ION DIFFUSION, FREEZING POINTS, HYGROSCOPIC WATER, SALINITY Freeze-thaw conditioning of water and wastewater sludges is known to be an effective and economical means of promoting

dewatering when natural freezing is employed. When sludge freezes, both the suspended and dissolved solids are rejected by the growing ice front. Particles trapped in ice have a very thin layer of surrounding water which does not freeze at normal temperatures. Dissolved solids are thought to accumulate in this layer, causing an increase in the ionic strength of the water. This may cause compression of the double layer, leading to neutralization of repulsive forces, thus promoting aggregation. In order to test this hypothesis, ionic strength was increased by adding sodium chloride (NaCl) to water and wastewater sludges and measuring dewaterability (filtration) with a capillary suction time (CST) apparatus. Four different kinds of sludge were used: alum sludge (water treatment), waste-activated sludge, simultaneous precipitation, and anaerobically digested mixed sludge. Salinities of 0-20,000 mg/L as NaCl were tested with every sludge. No enhancement in dewaterability with freeze-thawed sludges of raised ionic strength compared to zero salinity was recorded, therefore the hypothesis of double layer compression being a major factor in freeze-thaw conditioning is apparently invalid.

MP 3032
ANTARCTIC FIELDS.

Mellor, M., Symposium on Antarctic Logistics and Operations, Fourth, Sao Paulo, Brazil, 1990. Proceedings, edited by H. Kohnen, A.J. Teixeira, and A.N. Fowler, Brasilia, Brazil, Gráfica e Editora Ideal, Ltda, [1991], p.162-173, 7 refs. 46-3017

RUNWAYS, SNOW STRENGTH, BEARING STRENGTH, SURFACE ROUGHNESS

Following a summary of recent U.S. air activities in Antarctica, aircraft runways are considered. Various airfield options from open-field landings to conventional paved runways are dealt with, the relevant factors being given in tables that cover (a) construction and maintenance and (b) operations. Bearing capacity, rutting resistance, surface roughness and runway dimensions are discussed. It is concluded that a system of hard-surface runways for conventional aircraft is technically feasible. (Auth.)

MP 3033
U.S. ARMY CORPS OF ENGINEERS REAPS MANY GIS REWARDS.

Bruzewicz, A.J., *GIS world*, Mar. 1992, p.44-50. 46-3058

ENVIRONMENTAL IMPACT, COMPUTER PROGRAMS, RESEARCH PROJECTS, DATA PROCESSING, REMOTE SENSING, MAPPING

MP 3034
SYSTEMATIC CONSIDERATION OF THE ENVIRONMENT IN THE DEVELOPMENT OF SMART WEAPONS SYSTEMS.

Link, L.E., Jr., West, H.W., *Military engineer*, Aug. 1991, p.14-15. 46-3059

INFRARED PHOTOGRAPHY, DETECTION, MILITARY RESEARCH

MP 3035
OPERATION OF MATERIEL AT EXTREMELY LOW TEMPERATURES.

Diemand, D., *Military engineer*, Aug. 1991, p.24-25, 4 refs. 46-3060

ENGINE STARTERS, LUBRICANTS, FUELS, COLD WEATHER PERFORMANCE, MILITARY EQUIPMENT

MP 3036
INFRARED ROOF WARRANTY INSPECTION.

Korhonen, C.J., *Military engineer*, Aug. 1991, p.32-33, 4 refs. 46-3061

ROOFS, MOISTURE DETECTION, INFRARED PHOTOGRAPHY

MP 3037
PROGRESS IN THE IMPROVEMENT OF HDS PERFORMANCE.

Marsh, C., Segan, E.G., Phetteplace, G.E., *Military engineer*, Aug. 1991, p.34-35. 46-3062

MILITARY FACILITIES, WATER PIPELINES, HEATING, HEAT TRANSMISSION

MP 3038
REMOTE SENSING OF THE ALASKAN AND PERSIAN GULF OIL SPILL.

Link, L.E., Jr., McKim, H.L., *Military engineer*, Aug. 1991, p.52-53. 46-3063

SPACEBORNE PHOTOGRAPHY, DATA PROCESSING, OIL SPILLS, REMOTE SENSING

MP 3039
DISCUSSION OF "THE EFFECT OF LATEX GLOVES AND NYLON CORD ON GROUND WATER SAMPLE QUALITY".

Parker, L.V., *Ground water monitoring review*, Fall 1991, 2p., 13 refs. Original article by J.L. Canova and M.G. Muthig appeared in *Ground water monitoring review*, Spring 1991, Vol.11, No.3, p.98. 46-3064

SOIL POLLUTION, GROUND WATER

MP 3040
PERFORMANCE OF GROUND-COUPLED HEAT PUMPS IN MILITARY FAMILY HOUSING UNITS.

Phetteplace, G.E., Ueda, H., Carbee, D.L., *Solar engineering*, New York, American Society of Mechanical Engineers, 1992, p.377-383, 6 refs. 46-3065

MILITARY FACILITIES, RESIDENTIAL BUILDINGS, HEAT RECOVERY, COOLING SYSTEMS, HEAT SINKS, HEAT SOURCES, HEAT PUMPS

As part of a program to demonstrate appropriate technologies for saving energy in military facilities, 10 ground-coupled, water-to-air heat pump systems have been installed at Ft. Polk, LA. The systems were installed in housing units that are three-bedroom, two-story residences with four residences per building. Each heat pump system is coupled to two closed-loop vertical exchangers of 61-m (200-ft) depth. Five of the systems have desuperheater domestic hot water heat recovery units. The performance of each of the 10 heat pump systems is being closely monitored. In the heating mode both units with desuperheaters and units without achieved COPs (coefficients of performance) averaging 3.5. In the cooling mode, the average COP of units equipped with desuperheaters was 3.0, while those without desuperheaters achieved an average COP of 2.5.

MP 3041
DEVELOPMENT OF FIELD SCREENING METHODS FOR TNT, 2,4-DNT AND RDX IN SOIL.

Jenkins, T.F., Walsh, M.E., *Talanta*, 1992, 39(4), p.419-428, 27 refs. 46-3066

CHEMICAL ANALYSIS, DETECTION, SOIL POLLUTION, SOIL CHEMISTRY, EXPLOSIVES

Simple field-screening methods are presented for detecting 2,4,6-TNT, 2,4-DNT and RDX in soil. A 20-g portion of soil is extracted by manually shaking with 100 ml of acetone for three minutes. After the soil settles, the supernatant is filtered and divided into three aliquots. Two aliquots are reacted with potassium hydroxide and sodium sulfite to form the red-colored Janowsky complex when 2,4,6-TNT is present or the blue-purple complex when 2,4-DNT is present. The third aliquot of the extract is passed through a strong anion exchange resin to remove nitrate and nitrite. Then the extract is acidified and RDX is reduced with zinc to nitrous acid, which is reacted with a Griess reagent to produce a highly colored azo dye. Concentrations of TNT, 2,4-DNT and RDX are estimated from their absorbances at 540, 570 and 507 nm, respectively. Detection limits are about 1 microgram/g for 2,4,6-TNT and RDX and about 2 micrograms/g for 2,4-DNT. Concentration estimates from field analyses correlate well with laboratory analyses.

MP 3042
EXPERIMENTAL STUDY OF ELECTROMAGNETIC WAVE PROPAGATION IN DENSE RANDOM MEDIA.

Koh, G., *Waves in random media*, 1992, Vol.2, p.39-48, 12 refs. 46-3067

ELECTROMAGNETIC PROPERTIES, SCATTERING, WAVE PROPAGATION, RADAR ECHOES

Controlled experiments have been conducted to measure the propagation of synthetically generated pulses in dense random media. The dense media were prepared by embedding spherical dielectric scatterers in a homogeneous background medium; the size and volume fraction of the scatterers were the controlled parameters. A network analyzer-based system operating in the frequency domain was used to measure the electric field reflected and transmitted by slab-shaped samples of dense media as the source signal was swept from 26.5 to 40 GHz. An inverse Fourier transform was used to convert the frequency domain response into time domain pulse waveforms. The time domain response was then used to obtain pulse propagation velocity and attenuation in the controlled samples. The experimental results are shown to be in general agreement with dense medium theories.

MP 3043
EFFECTIVE DIELECTRIC CONSTANT OF A MEDIUM WITH SPHERICAL INCLUSIONS.

Koh, G., *IEEE transactions on geoscience and remote sensing*, Jan. 1992, 30(1), p.184-186, 8 refs. 46-3068

RADAR ECHOES, MICROWAVES, DIELECTRIC PROPER-

TIES, WAVE PROPAGATION

The Maxwell-Garnett theory is frequently used to predict the effective, or the average, dielectric constant of a mixture composed of spherical inclusions embedded in a host medium. The effective medium theory assumes that the volume fraction occupied by the spherical inclusions is small and that the size of the inclusions is small compared to the wavelength. Experiments using controlled samples have shown that the Maxwell-Garnett theory is applicable up to an inclusion volume fraction of 0.2. At higher volume fractions, the effective dielectric constant appears to be dependent on the inclusion sizes.

MP 3044

PERFORMANCE ASSESSMENT OF FOUR ENVIRONMENTAL ANALYTICAL CONTRACT LABORATORIES.

McGee, I.E., Grant, C.L., Jenkins, T.F., Stutz, M.H., *American environmental laboratory*, Feb. 1992, 4(1), p.11-19, 3 refs.

46-3069

LABORATORIES, ENVIRONMENTAL IMPACT, CHEMICAL ANALYSIS, SOIL CHEMISTRY, SOIL POLLUTION

MP 3045

SPECIFICATION-BASED MODIFIED CONTROL LIMITS IN QUALITY CONTROL OF TRACE CHEMICAL ANALYSES.

Grant, C.L., McGee, I.E., Jenkins, T.F., Stutz, M.H., *Association of Official Analytical Chemists International. AOAC International journal*, 1992, 75(1), p.39-45, 11 refs.

46-3070

LABORATORY TECHNIQUES, CHEMICAL ANALYSIS, STATISTICAL ANALYSIS

Shewhart X and R charts were used to maintain and validate data quality of percent recovery estimates for 8 analytes determined by 4 procedures used routinely in 4 commercial laboratories over a 2-year period. However, because range (R) estimates of uncertainty did not include lot-to-lot calibration variability, approximately 24% of the lots were "out-of-control." The authors pooled standard deviations for S(O) (repeatability within lot), S(L) (calibration variability), and S(R) (reproducibility), which represents the total variability. Values of S(O) and S(L) were generally similar in size although there were some substantial differences between analytes and between laboratories for a given analyte. When control limits were based on reproducibility rather than repeatability, only about 6% of the lots were "out-of-control." However, these limits are less convenient to compute at the bench, within-lot precision estimates are still required, and there is still no information on data acceptability. Capability estimates from the grand mean ± 3 S(R) were surprisingly consistent for the 8 analytes. These values coupled with data quality objectives suggested the 82-115% range as the specifications for acceptable individual recoveries. A combination of repeatability limits plus modified limits anchored to specifications retains the simplicity of range computations while offering substantial administrative advantages. Examples are given to illustrate these points.

MP 3046

APPARENT DONOR-ACCEPTOR INTERACTION BETWEEN NITROAROMATICS AND ACETONITRILE.

Leggett, D.C., Miyares, P.H., Jenkins, T.F., *Journal of solution chemistry*, 1992, 21(1), p.105-108, 11 refs.

46-3071

EXPLOSIVES, WATER CHEMISTRY, HYDROCARBONS, HYDROGEN BONDS, SOLUTIONS, CHEMICAL PROPERTIES

The partitioning behavior of nitro-aromatics in octanol-water and acetonitrile/NaCl-saturated water was examined. The nitro group contribution is opposite in the two systems, from which two different bonding mechanisms were inferred. In addition to cavity effects the octanol-water system is characterized by H-bonding of water to the nitro groups, while in the acetonitrile/NaCl-saturated water system electron donor-acceptor complexation predominates. A linear free-energy relationship which relates the partition coefficients in the two systems was $\log P(\text{aw}) = 0.727 \log P(\text{ow}) + 0.395 n + 0.742$, where n is the number of nitro groups per ring.

MP 3047

COUPLED VERTICAL AND HORIZONTAL GALLOPING.

Jones, K.F., *Journal of engineering mechanics*, Jan. 1992, 118(1), p.92-107, 26 refs.

46-3072

VIBRATION, ANALYSIS (MATHEMATICS), POWER LINE ICING, ICE LOADS, WIND PRESSURE

Galloping can occur when wind blows on ice-coated conductors. In this paper, the linearized coupled vertical-horizontal galloping equations are derived and the eigenvalues defining the motion are determined analytically. The intrinsic coupling between the vertical and horizontal equations requires that there be no vertical motion if the horizontal motion is constrained. Furthermore, vertical galloping may be initiated by a horizontal displacement or velocity. The solution of the eigenvalue equation indicates that

the coupled galloping criterion may be either more or less stringent than Den Hartog's criterion. The galloping trajectory is either a straight line at a small angle to the vertical, or under more extreme conditions, defines an elliptical envelope. Solutions are obtained for four cases chosen from the literature to illustrate the effect of different combinations of values of the aerodynamic parameters.

MP 3048

PASSIVE MICROWAVE REMOTE AND IN SITU MEASUREMENTS OF ARCTIC AND SUBARCTIC SNOW COVERS IN ALASKA.

Hall, D.K., Sturm, M., Chacho, E.F., Jr., *Remote sensing of environment*, 1991, Vol.38, p.161-172, 46 refs.

46-3073

SNOW STRATIGRAPHY, SNOW DENSITY, SNOW TEMPERATURE, MICROWAVES, RADIOMETRY, SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW DEPTH, UNITED STATES—ALASKA

Between 11 and 19 Mar. 1988, airborne and satellite passive microwave measurements were acquired simultaneously with ground measurements of depth, density and stratigraphy of the snow in central and northern Alaska. Five aircraft flights were flown along a north-south transect between about 147N and 152W, and extending from about 63N (south of Fairbanks, AK) to the Arctic Ocean coastline, with an Aircraft Multichannel Microwave Radiometer (AMMR) on-board operating at 92, 37, 21, and 18 GHz. Passive microwave data from the satellite-borne Special Sensor Microwave Imager (SSM/I), operating at 85.5, 37, 21, 18, and 10 GHz, were obtained concurrently. A good correspondence in brightness temperature (TB) trends between the aircraft and satellite data was found. However, an expected inverse correlation between depth hoar thickness and TB was not found to be strong. A persistent TB minimum in both the aircraft and the satellite data was detected along the northern foothills of the Brooks Range. In an area located at about 69N, 149W, the TB as recorded from the aircraft microwave sensor dropped by 55 K. Satellite microwave measurements showed a TB decrease of up to 45 K at approximately the same location. Snow pit measurements did not reveal notable differences in snow characteristics or depth in this location. An examination of passive microwave satellite data from 1978 to 1987 revealed that similar low late-winter TB values were found in approximately the same locations as those observed in Mar. 1988. According to the satellite data, the zone of low TB develops as the snow deepens, and reaches the lowest values in Mar. or Apr. each year. The cause of this TB minimum is unknown, but thought to be related to snow stratigraphy. The observed difficulty in relating the ground measurements to data collected using aircraft and satellite passive microwave sensors is attributed to the fact that the snow depth and character are highly variable in central and northern Alaska. This variability is exemplified in the field measurements as well as in the passive microwave measurements.

MP 3049

DYNAMICS OF INFRARED AND MILLIMETER-WAVE ENVIRONMENTS ISSUES FOR SCENE SIMULATION.

Davis, R.E., Boyne, H.S., Nagle, J.A., Link, L.E., Jr., *Ground Target Modeling and Validation Conference*, 2nd. Proceedings, Houghton, Michigan Technological University, Aug. 1991, 15p., 18 refs.

46-3074

INFRARED RECONNAISSANCE, SNOW THERMAL PROPERTIES, TEMPERATURE MEASUREMENT, SURFACE TEMPERATURE, BACKSCATTERING, RADAR ECHOES, SNOW COVER EFFECT, ENVIRONMENT SIMULATION

The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) is conducting research to understand and predict the interaction of electromagnetic radiation with cold regions environments. The CRREL efforts are a component of the U.S. Army Corps of Engineers Scene Dynamics Program which is designed to measure the environmental conditions during seeker/sensor field tests, to identify mechanisms by which the environment affects performance, and to develop a sufficient characterization of the environment to model the electromagnetic background response. The environmental effects can then be assessed quantitatively and incorporated into the sensor system design. During the winters of 1988, 1990, and 1991, CRREL conducted field tests to monitor background scene dynamics during the Joint Munitions Test and Evaluation Program Office (CHICKEN LITTLE JPO) captive flight tests at Grayling, MI. This paper presents an analysis of the effects of environmental processes on sensor performance based on the 1990 data. The impact of environmental variability on infrared and millimeter-wave systems will be stressed. A decision tree approach is used to classify expected sensor system performance as a function of near-surface meteorological conditions which affect the surface energy exchange. Issues for distributing this approach spatially to mixed background scenes will be discussed.

MP 3050

MOVING BOUNDARY STEP ICE FORMATION IN TURBULENT FLOW.

Albert, M.R., *Numerical methods in thermal problems*, Vol.VII, edited by R.W. Lewis, et al, Swansea,

Wales, Pineridge Press, 1991, p.101-111, 14 refs.

46-3075

LIQUID SOLID INTERFACES, PHASE TRANSFORMATIONS, HEAT TRANSFER, BOUNDARY VALUE PROBLEMS, MATHEMATICAL MODELS, TURBULENT FLOW, ICE FORMATION

For solidification processes involving fluid flow in the melt, the nature of the flow field has a profound influence on the configuration of the solid-liquid interface, especially when the flow is turbulent. In order to investigate solidification problems in turbulent flow, a numerical moving boundary method is presented for arbitrary geometries in two dimensions. It is the first moving mesh method to include the solution of the turbulent flow field as part of the calculations. The importance of including detailed calculations in the flow field is illustrated in an application involving ice formation in turbulent flow between parallel plates. The application illustrated here represents the first theoretical prediction of irregular ice profiles resulting from freezing of flow in a uniform duct with uniform boundary conditions.

MP 3051

ANTICIPATING ENVIRONMENTALLY RELATED CHANGES IN THE DETECTION CAPABILITY OF EXTERIOR INTRUSION DETECTION SYSTEMS.

Peck, L., Northbrook, IL, Institute of Nuclear Material Management, 1991, p.546-550, 4 refs. Presented at the 32nd annual meeting, New Orleans, July 2-31, 1991.

46-3076

SITE ACCESSIBILITY, COLD WEATHER TESTS, DETECTION, WARNING SYSTEMS

Changes in detection capability due to winter and transitional environments have been determined for several exterior intrusion detection systems (IDS) by means of controlled intrusions and long-term monitoring of IDS performance. These changes have been evaluated in terms of environmental effects on the phenomenology by which each IDS detects an intruder. This paper summarizes the dependence of detection capability on operating environment. It identifies the site conditions (weather, snow cover, frozen/thawed state of the ground) that should be monitored in order to anticipate when and what changes in detection capability are occurring. Guided by an awareness of IDS performance as a function of the environment, security personnel may avoid vulnerabilities in detection capability by adjusting IDS sensitivity to maintain the required probability of detection without incurring unacceptable nuisance alarm rates.

MP 3052

RELAXATION OF THE SECOND MOMENTS IN RAPID SHEAR FLOWS OF SMOOTH DISKS.

Louge, M.Y., Jenkins, J.T., Hopkins, M.A., U.S./Japan Conference on the Micro-Mechanics of Granular Materials, 4th, Potsdam, NY, Aug. 4-7, 1991. Proceedings, 1991, 9p., 2 refs.

46-3077

MATHEMATICAL MODELS, SHEAR FLOW, AVALANCHE MODELING

This paper compares the results of numerical simulations for two-dimensional, rapid, homogeneous shear flows of identical smooth inelastic disks with the predictions of Jenkins and Richman for the relaxation of the second moments of the velocity distribution function following a homogeneous but anisotropic disturbance of their steady values. For nearly elastic disks, the time-history of the relaxation is in excellent agreement with the theory in both its dense and dilute limits. However, deviations are observed in the case of inelastic particles.

MP 3053

ON THE STRUCTURE OF 3D SHEAR FLOWS.

Hopkins, M.A., Jenkins, J.T., Louge, M.Y., U.S./Japan Conference on the Micro-Mechanics of Granular Materials, 4th, Potsdam, NY, Aug. 4-7, 1991. Proceedings, 1991, 9p., 11 refs.

46-3078

STATISTICAL ANALYSIS, SHEAR FLOW, AVALANCHE MODELING

This paper describes an investigation of structure in moderately dilute three-dimensional shear flows. Structure is defined as a dynamic inhomogeneity or fluctuation in the spatial concentration field. Numerical experiments are performed with large numbers of identical frictionless, inelastic spheres. The spheres are contained in a fully periodic cubic control volume. A state of shear is maintained in the control volume by moving the upper periodic image in one direction and the lower image in the opposite direction. As the coefficient of restitution of the spheres is lowered, conditions in the control volume deviate from a state of simple shear, exhibiting strong wavelike fluctuations in the concentration, stress, and velocity fields. Visual inspection of the spatial concentration field reveals a strong tendency for spheres with a low coefficient of restitution to form dense clouds. The clouds are, in general, oriented such that they are aligned with the mean velocity and normal to the direction of the mean velocity gradient created by the moving periodic images of the control volume.

MP 3054

SPATIAL VARIABILITY OF CaCO₃ SOLUBILITY IN A CHIHUAHUAN DESERT SOIL.

Marion, G.M., Schlesinger, W.H., Fonteyn, P.J., *Arid soil research and rehabilitation*, 1990, Vol.4, p.181-191, 24 refs.

46-3079

GEOCHEMISTRY, SOLUBILITY, NUTRIENT CYCLE, SOIL PROFILES, SOIL CHEMISTRY, DESERT SOILS, UNITED STATES—NEW MEXICO

Spatial variability in CaCO₃ solubility is an important factor in parameterizing simulation models and designing experiments. The objective of this study was to quantify the spatial variability, both horizontal and vertical, in CaCO₃ solubility in a Chihuahuan Desert soil. CaCO₃ solubilities were estimated in 1:5 soil:water suspensions. Soil horizon extracts were generally supersaturated with respect to calcite. The mean (± 1 SE) pIAP(CaCO₃) for the A, B(k1), and B(k2) horizons were 8.03 (0.055), 8.19 (0.019), and 8.26 (0.015), respectively. The differences in pIAP between the A and B horizons (vertical variability) were statistically significant; these differences could be due to organic matter inhibition of calcite precipitation. Supersaturation with respect to calcite and vertical variability in CaCO₃ solubility needs to be explicitly considered in simulation models. The standard errors in pIAP (horizontal variability) were greatest for the A horizons and decreased with increasing soil depth. Given the inherent variability in CaCO₃ solubility, a large sample size is necessary to detect small differences in CaCO₃ solubility for this Chihuahuan Desert soil.

MP 3055

STABLE ISOTOPE GEOCHEMISTRY OF CaCO₃ ON THE TANANA RIVER FLOODPLAIN OF INTERIOR ALASKA, U.S.A.: COMPOSITION AND MECHANISMS OF FORMATION.

Marion, G.M., Introne, D.S., Van Cleve, K., *Chemical geology. Isotope geoscience section*, 1991, Vol.86, p.97-110, 43 refs.

46-3080

ISOTOPE ANALYSIS, NUTRIENT CYCLE, FOREST SOILS, FLOODPLAINS, PLANT ECOLOGY, EVAPOTRANSPIRATION, SOIL CHEMISTRY, GEOCHEMISTRY, REVEGETATION, UNITED STATES—ALASKA—TANANA RIVER

On the river floodplains of interior Alaska, forests exist on calcareous, alluvial soils. The objectives of this study were to determine the stable C-13 and O-18 isotopic composition of CaCO₃ along a plant primary successional sequence (250 yr.) and to examine possible mechanisms controlling the formation of CaCO₃ in these floodplain soils. Soil samples were analyzed from duplicate plots of three successional stages: open shrub (Stage III, 4 yr. old), young balsam poplar-alder (Stage V, 30 yr. old), and mature white spruce (Stage VIII, 170-250 yr. old). The early stages of plant succession showed little variation in the mean soil delta C-13 PDB (-4.3 to -4.0 per mil), while the Stage VIII sites showed the greatest carbon depletion (delta C-13 PDB = -7.9 to -6.2 per mil). The mean soil delta O-18 PDB values ranged from -16.3 to -14.6 per mil. These low delta O-18 values reflect, in part, the very depleted meteoric precipitation (delta O-18 PDB = -50.3 per mil) for this cold continental site. A few surface "salt crust" samples showed significant enrichment in both C and O isotopes. Six calcite-bearing rock samples from the Alaska Range, the source of the alluvial parent material, fell into two classes with means for delta C-13 PDB of -0.2 and -5.2 per mil and means for delta O-18 PDB of -14.6 and -18.7 per mil, respectively. The early Stage III profiles showed little variation in isotopic composition with soil depth, suggesting that the CaCO₃ was primarily inherited with the alluvial material and was not formed in situ. Surface evaporation of water played a minor role and transpirational loss of water played a major role in altering the isotopic composition of soil CaCO₃ along the successional sequence. There was no evidence to support freezing as a mechanism controlling soil CaCO₃ precipitation. Over the 170-250 yr. old plant successional sequence, the biotic factor significantly altered the isotopic composition of soil CaCO₃.

MP 3056

PILOT-SCALE STUDY OF ALUM SLUDGE Dewatering IN A FREEZING BED.

Martel, C.J., Diener, C.J., *American Water Works Association. Journal*, Dec. 1991, 83(12), p.51-55, 13 refs.

46-3081

WATER TREATMENT, FREEZE THAW CYCLES, SLUDGES, ARTIFICIAL FREEZING, SEWAGE TREATMENT The purpose of this study was to demonstrate the capability of a sludge-freezing bed for dewatering alum sludge. Alum sludge containing average total solids of 0.5% was applied to the pilot-scale bed and frozen in layers 2-10 cm thick over the winter of 1989-90. By the end of the winter, 99 cm of sludge had been frozen. After thawing and draining of meltwater, the depth of sludge remaining in the bed was reduced to 3-5 cm, a 96% reduction in volume. The remaining solids had a granular consistency similar to medium-sized sand. The meltwater drained through the granular solids as easily as through the underlying sand. Column tests show that these granular solids could accumulate in the bed for

several years before removal would be necessary.

MP 3057

LONG-TERM CHANGES IN SOIL AND PLANT METAL CONCENTRATIONS IN AN ACIDIC DREDGE DISPOSAL SITE RECEIVING SEWAGE SLUDGE.

Palazzo, A.J., Reynolds, C.M., *Water, air, and soil pollution*, 1991, Vol.57/58, p.839-848, 28 refs.

46-3082

PLANT PHYSIOLOGY, PLANT TISSUES, REVEGETATION, WASTE DISPOSAL, LAND RECLAMATION, SEWAGE DISPOSAL, SLUDGES, SOIL CHEMISTRY A long-term experiment was conducted to determine the distribution of sludge-borne metals applied to a revegetated acidic dredge spoil disposal site. The initial soil was infertile and highly acidic (pH 2.4). Sewage sludge and lime were applied in 1974 at the rates of 100 and 23 metric tons/ha, respectively, and tilled into the soil to a depth of 20 cm. In 1974 an adjacent site was also revegetated with topsoil and lime but without sludge. Soil and plants were sampled 2, 4 and 16 yr following seeding. After 16 yr the total and DTPA-extractable Cu, Zn, Cr, Pb, Ni and Cd decreased in soils to nearly the levels of the control soils. Concentrations of metals in plants also decreased. Decreases in tissue concentrations ranged from 40 to 70% for Cu, Cr, Pb, Ni and Cd and up to 90% for Zn. The results showed that a single 100 metric tons/ha application of sewage sludge containing high concentrations of metals was a cost-effective method for improving plant growing conditions on highly acidic soils.

MP 3058

CAN LONG-PATH FTIR SPECTROSCOPY YIELD GAS FLUX MEASUREMENTS THROUGH A VARIANCE TECHNIQUE.

Andreas, E.L., Gosz, J.R., Dahm, C.N., *Atmospheric environment*, 1992, 26A(2), p.225-233, 44 refs.

46-3083

GASES, BOUNDARY LAYER, VAPOR TRANSFER, STATISTICAL ANALYSIS, ATMOSPHERIC COMPOSITION, INFRARED SPECTROSCOPY, TURBULENT EXCHANGE Long-path Fourier transform infrared (FTIR) spectroscopy is capable of measuring concentrations of many environmentally important trace gases in the atmospheric surface layer over horizontal averaging paths of up to 1 km. If the FTIR could also measure the variance in gas concentrations, one could conceivably use it to estimate the path-averaged vertical flux of any gas that the FTIR can detect. The problem in measuring variances, however, is that the large sampling volume—which allows the FTIR to measure concentrations with the best resolution—degrades its response to the high-wavenumber turbulent fluctuations that contribute to the variance. In this paper, the authors use a model for the three-dimensional scalar spectrum to look at the effects of this volume averaging on the FTIR's ability to measure gas concentration variance. The modeling suggests that there is no realistic configuration or sampling rate that will let the FTIR measure gas concentration variance in the surface layer. Its sampling volume must simply be so large that all turbulent fluctuations with wavenumbers from the dissipation region down to the vicinity of the spectral peak are irrevocably degraded. Analysis identifies experiments that can test these predictions. Despite the FTIR's predicted inability to measure gas fluxes through the variance technique, it is shown that it can still yield these fluxes through other micrometeorological techniques.

MP 3059

FREEZING OUT SLUDGE.

Martel, C.J., *Civil engineering*, Nov. 1991, 61(11), p.64-65.

46-3084

SLUDGES, WATER TREATMENT, SEWAGE TREATMENT, ARTIFICIAL FREEZING

MP 3060

COMBATting ICE DAMS AND SLIDING SNOW ON ROOFS.

Tobiasson, W., *American Public Works Association. APWA reporter*, Sep. 1991, 58(9), p.18-19.

46-3090

ROOFS, ICE CONTROL

MP 3061

SEA-ICE STUDIES ON THE WINTER WEDDELL GYRE STUDY, 1989.

Meese, D.A., Govoni, J.W., Lytle, V.I., Claffey, K.J., Ackley, S.F., *Antarctic journal of the United States*, 1990, 25(5), p.116-117, 4 refs.

46-3189

ICE CORES, ICE SURVEYS, ICE PHYSICS, REMOTE SENSING, SNOW, SEA ICE, ICE COMPOSITION The U.S. Army Cold Regions Research and Engineering Laboratory participated in the Winter Weddell Gyre Study, 1989 on both the *Polarstern* and the *Akademik Fedorov*. On the *Polarstern*, remote sensing work was performed with two radars, and the authors assisted in the ice properties studies. On the *Akademik Fedorov*, they conducted studies on the physical, optical, chemical, and biological properties of the sea ice and carried out a

detailed ice thickness study. For 12 days during the study, the *Akademik Fedorov* was moored to an ice floe to conduct extensive oceanographic and ice studies. Ice cores were collected to sample all of the various ice types available. Optical measurements were taken at 5 different locations in the area according to various ice type and thickness. In addition, five thickness profiles including a grid were taken through all anomalous locations, and one was taken in the usual manner to determine variations that may exist.

MP 3062

SNOW AND SEA-ICE THICKNESSES: WINTER WEDDELL GYRE STUDY, 1989.

Meese, D.A., Govoni, J.W., Ackley, S.F., *Antarctic journal of the United States*, 1990, 25(5), p.118, 6 refs.

46-3190

SEA ICE, ICE COVER THICKNESS, SNOW DEPTH, SNOW COVER EFFECT, ANTARCTICA—WEDDELL SEA During the Winter Weddell Gyre Study, 1989, 2,650 thickness holes were drilled at 29 different sites in the pack ice on the Weddell Sea from the Soviet icebreaker *Akademik Fedorov*. The primary objective of the study was to determine ice thickness, snow thickness, and freeboard variations within and among floes, and to examine the variations of these properties with geographic location in the Weddell Sea. Snow thicknesses ranged from 0 to 80 cm with a mean of 17.9 cm; ice thicknesses ranged from 0 to 279 cm with a mean of 64.9 cm; and freeboards ranged from -32 to 55 cm with a mean of 1.5 cm. Negative freeboards indicate that the top ice surface is below sea level; flooding of the ice was often observed at these locations. The values were visually examined in relation to latitude and longitude to determine if there was any consistent variation over the cruise track. A consistent trend was not evident.

MP 3063

OPTICAL MEASUREMENTS ON SEA ICE FROM THE WEDDELL SEA, ANTARCTICA.

Govoni, J.W., Meese, D.A., Perovich, D.K., *Antarctic journal of the United States*, 1990, 25(5), p.121-122, 6 refs.

46-3192

ICE PHYSICS, ICE STRUCTURE, SEA ICE, OPTICAL PROPERTIES, ICE COMPOSITION, SNOW COVER, ANTARCTICA—WEDDELL SEA

During the 1989 Winter Weddell Gyre Study, combined optical and physical properties measurements were made of first-year sea ice in the Weddell Sea. Optical measurements consisted of incident, reflected, and transmitted spectral irradiances. An essential adjunct to the optical measurements was a complete characterization of the physical state and structure of the ice. This was accomplished by taking two ice cores from each site. When snow cover was present, its depth and stratigraphy were also recorded. Snow cover properties were characterized in terms of depth, density, grain size, and temperature for each layer. Photographs were also taken at each site and a general description of the ice, snow, and sky conditions was recorded.

MP 3064

RADAR BACKSCATTER MEASUREMENTS DURING THE WINTER WEDDELL GYRE STUDY.

Lytle, V.I., Jezek, K.C., Gogineni, S.P., Moore, R.K., Ackley, S.F., *Antarctic journal of the United States*, 1990, 25(5), p.123-125, 5 refs.

46-3193

SNOW, SEA ICE, ICE SURFACE, RADAR, ICE COVER THICKNESS, ICE COMPOSITION, ICE DENSITY, ANTARCTICA—WEDDELL SEA

Data primarily taken over first and second year ice during the Weddell Sea cruise of F.S. *Polarstern* in Sep. and Oct. 1989 are discussed. Radar measurements were conducted in conjunction with detailed snow and ice measurements, including snow and ice thickness, surface roughness, salinities, and densities. One of the salient features found in the Weddell Sea second year ice, in contrast to arctic second year ice, was a deep snow cover which depressed the ice surface below sea level, causing brine to infiltrate into the snow and creating a highly saline layer at the snow/ice interface. An associated slush layer was observed where the snow had been flooded but had not refrozen. Because of either the high salinity layer or the presence of slush at the snow/ice interface observed in the Weddell Sea, the radar penetration depth is less, leading to a reduction in volume scattering relative to arctic sea ice.

MP 3065

GLACIER TERMINUS FLUCTUATIONS IN THE WRANGELL AND CHUGACH MOUNTAINS RESULTING FROM NON-CLIMATIC CONTROLS.

Sturm, M., Hall, D.K., Benson, C.S., Field, W.O., International Conference on the Role of the Polar Regions in Global Change, Fairbanks, June 11-15, 1990. Proceedings, Vol.2, Fairbanks, University of

Alaska, Dec. 1991, p.519-523, 26 refs.

46-3215

VOLCANOES, MOUNTAIN GLACIERS, GLACIER SURVEYS, GLACIER BEDS, GLACIER OSCILLATION, GLACIER FLOW, UNITED STATES—ALASKA

Non-climatically controlled fluctuations of glacier termini were studied in two regions in Alaska. In the Wrangell Mountains, eight glaciers on Mt. Wrangell, an active volcano, have been monitored over the past 30 years using terrestrial surveys, aerial photogrammetry and digitally registered satellite images. Results, which are consistent between different methods of measurement, indicate that the termini of most glaciers were stationary or had retreated slightly. However, the termini of the 30-km-long Ahnna Glacier and the smaller Center and South MacKeith glaciers began to advance in the early 1960s and have advanced steadily at rates between 5 and 18 m/yr since then. These three glaciers flow from the summit caldera of Mt. Wrangell near the active North Crater, where increased volcanic heating since 1964 has melted over 70 million cu m of ice. The authors suggest that volcanic meltwater has changed the basal conditions for the glaciers, resulting in their advance. In College Fjord, Prince William Sound, the terminus fluctuations of two tidewater glaciers have been monitored since 1931 by terrestrial surveying, photogrammetry, and most recently, from satellite imagery. Harvard Glacier, a 40-km-long tidewater glacier, has been advancing steadily at nearly 20 m/yr since 1931, while the adjacent Yale Glacier has retreated at approximately 50 m/yr during the same period, though for short periods both rates have been much higher. The striking contrast between the terminus behavior of Yale and Harvard Glaciers, which parallel each other in the same fjord, and are derived from the same snow field, supports the hypothesis that their terminus behavior is the result of dynamic controls rather than changes in climate.

MP 3066

POLAR CLIMATE ITERATION?

Hogan, A.W., et al, International Conference on the Role of the Polar Regions in Global Change, Fairbanks, June 11-15, 1990. Proceedings, Vol.2, Fairbanks, University of Alaska, Dec. 1991, p.681-686, 38 refs.

46-3237

AIR ICE WATER INTERACTION, AEROSOLS, ATMOSPHERIC CIRCULATION, POLAR ATMOSPHERES, ATMOSPHERIC COMPOSITION, AIR MASSES, ANTARCTICA—AMUNDSEN-SCOTT STATION

A continuous series of surface observations began at South Pole in 1974 and have continued to the present. Although a large seasonal variation in aerosol concentration is present, little year-to-year variation in mean seasonal aerosol concentration occurred prior to 1982. During the mid-1980s, a consistent diminution of mean annual aerosol concentration was observed, and a concurrent reduction in sodium concentration in snow and firn was reported. The decrease in aerosol concentration was greatest in late winter and spring, concurrent with decreases in mean air temperature and mean wind speed. This paper describes concurrent aerosol and meteorological data collected at South Pole from 1974 through 1987 and presents several analyses attempting to verify if these changes do reflect a persistent variation in the properties of the antarctic continental air mass. Additional analyses, using upper air and automatic weather station data, attempt to identify circulation changes related to these changes in aerosol concentration. (Auth. mod.)

MP 3067

ALASKA WATER ISSUES.

Chacho, E.F., Jr., ed, Fairbanks, American Water Resources Association, Alaska Section. University of Alaska, Water Research Center, 1992, 209p., WRC-114, Refs. passim. Proceedings of the AWRA Alaska Section annual meeting, Apr. 9-10, 1992. For selected papers see 46-3263 through 46-3276.

46-3262

SOIL POLLUTION, WATER TREATMENT, PERMAFROST HYDROLOGY, WATER POLLUTION, WATER CHEMISTRY, WATER RESERVES, WETLANDS, UNITED STATES—ALASKA

MP 3068

TRAVEL DISTANCES OF COARSE SEDIMENT PARTICLES IN RIVERS.

Burrows, R.L., Chacho, E.F., Jr., Emmett, W.W., Alaska water issues, Fairbanks, American Water Resources Association, Alaska Section. University of Alaska, Water Research Center, 1992, p.89-90, 7 refs. Presented at the AWRA Alaska Section annual meeting, Apr. 9-10, 1992.

46-3269

SEDIMENT TRANSPORT, SUSPENDED SEDIMENTS, RIVER FLOW

MP 3069

WHITE PHOSPHOROUS CONTAMINATION OF AN ALASKAN SALT MARSH: EAGLE RIVER FLATS.

Collins, C.M., Racine, C.H., Walsh, M.E., Alaska water issues, Fairbanks, American Water Resources Association, Alaska Section. University of Alaska, Water Research Center, 1992, p.99, Presented at the AWRA Alaska Section annual meeting, Apr. 9-10, 1992.

46-3271

ENVIRONMENTAL IMPACT, EXPLOSIVES, BOTTOM SEDIMENT, MILITARY FACILITIES, WETLANDS, SOIL POLLUTION, UNITED STATES—ALASKA—FORT RICHARDSON

MP 3070

ROAD AND AIRPORT PAVEMENT RESPONSE MONITORING SYSTEMS.

Janoo, V.C., ed, Eaton, R.A., ed, New York, American Society of Civil Engineers, 1992, 429p., Refs. passim. Proceedings of a conference sponsored by the U.S. Army Cold Regions Research and Engineering Laboratory, West Lebanon, NH, Sep. 12-16, 1991. For selected papers see 46-3323 through 46-3330.

46-3322

THAW WEAKENING, SEASONAL FREEZE THAW, STRAIN MEASURING INSTRUMENTS, PAVEMENTS, SOIL TRAFFICABILITY, GROUND THAWING, FROST RESISTANCE

MP 3071

INSTRUMENTATION FOR VEHICLE MOBILITY TESTING IN THE FROST EFFECTS RESEARCH FACILITY.

Berliner, E., Shoop, S.A., Road and airport pavement response monitoring systems. Edited by V.C. Janoo and R.A. Eaton, New York, American Society of Civil Engineers, 1992, p.12-26, 4 refs.

46-3323

FROST PENETRATION, THAW DEPTH, LABORATORIES, MEASURING INSTRUMENTS, TEST EQUIPMENT, GROUND THAWING, SOIL TRAFFICABILITY, TRACTION
Vehicle mobility in thawing soils is currently being studied in the Cold Regions Research and Engineering Laboratory's (CRREL) Frost Effects Research Facility (FERF). The instrumentation used to accomplish this can be divided into two classes. One set of instruments is devoted solely to determination of soil conditions and is imbedded in the test surface. This set consists of thermistors for determining depth of freeze, and tensiometers for determining moisture content. The remainder of the instruments are mounted on the vehicle and are used to measure speed, force, and temperature. The CRREL instrumented vehicle (CIV) is equipped with a fifth wheel and ultrasonic speed sensor for measuring vehicle speed, and proximity gauges and counters for measuring individual wheel speeds. The forces at the interface between the tire and the ground are measured by triaxial load cells. These load cells sense longitudinal (direction of travel), transverse (perpendicular to direction of travel), and vertical forces on the tire. Vehicle temperature is measured using thermocouples.

MP 3072

INSTRUMENTATION FOR CHARACTERIZING SEASONAL CHANGE IN PROPERTIES OF PAVEMENT STRUCTURES.

Haupt, R.S., Bull, D.C., Road and airport pavement response monitoring systems. Edited by V.C. Janoo and R.A. Eaton, New York, American Society of Civil Engineers, 1992, p.125-137, 6 refs.

46-3324

MEASURING INSTRUMENTS, SEASONAL FREEZE THAW, GROUND THAWING, THAW WEAKENING, SOIL TRAFFICABILITY, PAVEMENTS

Pavement analysis techniques have been unable to effectively predict and account for variations in the in situ properties of pavement structures as their relative strengths adjust to seasonal changes in moisture and temperature. A joint research project between the Vermont Agency of Transportation (VAOT) and the U.S. Army Cold Regions Research & Engineering Laboratory (CRREL) has been initiated to evaluate in situ variations in the moduli of representative pavement layers as their structural properties are influenced by seasonal changes. Seven tests at five locations representing diversified examples of pavement sections and conditions are being instrumented to measure variations in support strength characteristics resulting from seasonal changes in weather, moisture and temperature. The objective of this paper is to present examples of prior and future instrumentation that has been investigated in an attempt to obtain the information necessary for effective evaluation of support characteristics that are needed for optimizing pavement design procedures.

MP 3073

MEASUREMENT OF SHOCK PRESSURE FROM FWD ON A CONCRETE PAVEMENT BY IMPEDANCE-MATCHED SHOCK GAUGE.

Dutta, P.K., Kalafut, J., Road and airport pavement response monitoring systems. Edited by V.C. Janoo and R.A. Eaton, New York, American Society of Civil Engineers, 1992, p.213-228, 7 refs.

46-3329

CONCRETE STRENGTH, IMPACT TESTS, SHOCK WAVES, CONCRETE PAVEMENTS, STRAIN MEASURING INSTRUMENTS, SOIL STRENGTH

This paper summarizes the installation, acquisition, and analysis of data from impedance-matched shock gauges developed at CRREL and installed in the Frost Effects Research Facility experimental pavement. The gauges were made with shock sensitive piezopolymer sensors embedded in specially formulated materials to match the shock impedance of concrete and soils in which they were installed. Measured data were compared with the values predicted from Boussinesq's solution for concentrated load modified for uniformly distributed circular load. Results from the numerical analysis using the computer code JULEA were also compared. Measured data are in greater agreement (within 15%) with the results predicted from the numerical analysis than with the modified Boussinesq solution. The shock gauges continued to function over a period of three months without any degradation.

MP 3074

HYDRAULIC/GEOMORPHIC RELATIONSHIPS IN A BRAIDED TO MEANDERING TRANSITION.

Neill, C.R., Collins, C.M., XXIV IAHR Congress, Madrid, Sep. 9-13, 1991, Madrid, International Association for Hydraulic Research, 1991, p.A/139-A/147, 9 refs.

46-3369

FLOOD CONTROL, HYDRAULICS, RIVER FLOW, SEDIMENT TRANSPORT, CHANNELS (WATERWAYS), UNITED STATES—ALASKA—TANANA RIVER

MP 3075

COMPUTER SIMULATIONS OF RAPID GRANULAR FLOWS INTERACTING WITH A FLAT, FRICTIONAL BOUNDARY.

Louge, M.Y., Jenkins, J.T., Hopkins, M.A., New York, American Society of Civil Engineers, 1991, 6p., 2 refs. Presented at the ASCE conference, Columbus, OH, May 20-22, 1991.

46-3109

COMPUTERIZED SIMULATION, PRESSURE RIDGES, FLUID MECHANICS, BOUNDARY VALUE PROBLEMS, RHEOLOGY, SHEAR FLOW

MP 3076

OBSERVED ICE PASSAGE FROM LAKE HURON INTO THE ST. CLAIR RIVER.

Daly, S.F., *Journal of great lakes research*, 1992, 18(1), p.61-69, 8 refs.

46-3611

STATISTICAL ANALYSIS, ICE JAMS, SURFACE STRUCTURE, LAKE ICE, RIVER ICE, ICE PASSING, ICE CONDITIONS, ICE FORECASTING, PHOTOINTERPRETATION, UNITED STATES—ST. CLAIR RIVER

Ice entering the St. Clair River from southern Lake Huron has caused large ice jams on the river, which have inundated large inhabited areas and delayed navigation. Study and forecasting of these ice jam events require that the ice passage from the lake into the river be described quantitatively. This paper analyzes data obtained from time-lapse photography of ice conditions at the entrance of the river at Lake Huron over six winters. For each day of record when ice was observed in Lake Huron or the river, the presence or absence of an ice arch and the daily average surface concentration of ice entering the river were noted. For the months of Jan. through Apr., separate means, standard deviations, and distributions of the surface ice concentration were determined for periods when the ice arch was present or absent. The existence of the ice arch can be predicted by a simple indicator based on air temperature. The statistical distributions of ice concentration are strongly influenced by the presence or absence of the ice arch. The overall mean surface ice concentration was 9.5% with an arch present and 27.3% with no arch. Based on this finding, ice passage can be forecast.

MP 3077

ANALYSIS OF RIVER ICE MOTION NEAR A BREAKING FRONT.

Ferrick, M.G., Weyrick, P.B., Hunnewell, S.T., *Canadian journal of civil engineering*, Feb. 1992, 19(1), p.105-116, With French summary. 9 refs. For another source see 46-1871.

46-3615

DYNAMIC PROPERTIES, WAVE PROPAGATION, ANALYSIS (MATHEMATICS), RIVER ICE, HYDRODYNAMICS, ICE MECHANICS, ICE BREAKUP, BOUNDARY LAYER,

ICE WATER INTERFACE

Dynamic river ice breakup displays different behaviors depending on the physical characteristics of the river, the flow, and the ice cover. Although a quantitative theory of dynamic breakup is not yet available, one of the essential components of such a theory will be a description of the ice motion near the breaking front. In this paper, an analysis of this motion for a specific case is developed. The analysis is generalized by allowing the speed of the breaking front to vary, and the parameters of the ice motion that are obtained represent different dynamic breakup behaviors that have been previously described. The results of the analysis include (i) the ice velocity, ice acceleration, and bank resistance at each point in a river reach as functions of time, (ii) the equilibrium ice velocity as a function of bank resistance and the ice velocity as a function of time for several initial and bank resistance conditions, and (iii) the time of ice motion, ice velocity, ice acceleration, and the convergence of the moving ice with distance from the breaking front. The measure of ice convergence quantifies the loss of surface area by the sheet required for ice continuity, and distinguishes the basic types of dynamic breakup.

MP 3078

RIM: RIVER ICE MANAGEMENT.

U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH, Sep. 1981, 33p.
46-2613

ICE CONDITIONS, RESEARCH PROJECTS, TRANSPORTATION, RIVER ICE, ICE CONTROL

MP 3079

DESIGNING SMALL-BOAT HARBORS FOR ICE CONDITIONS.

U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH, [1985], 21p.
46-2607

ICE CONDITIONS, PORTS, ICE CONTROL

MP 3080

MODEL FOR VERTICAL FRAZIL DISTRIBUTION.

Liou, C.P., Ferrick, M.G., *Water resources research*, May 1992, 28(5), p.1329-1337, 30 refs.
46-3723

ICE STRUCTURE, ANALYSIS (MATHEMATICS), SUPER-COOLING, FRAZIL ICE, ICE FORMATION, TURBULENT FLOW, WATER FLOW, BUOYANCY, ICE WATER INTERFACE, ICE MODELS

In this paper, a model is presented for the evolution of frazil over depth and with time in a turbulent flow. The net upward migration due to buoyancy of the frazil is opposed by intermittent mixing induced by large energy-containing eddies. A surface renewal model is used to describe the effects of large eddy mixing. Parameters that represent an entire water body are obtained by averaging those of discrete water columns, using a probability density function. These parameters include the concentration profile, the surface age, and the surface layer thickness. A dimensionless surface renewal frequency characterizes the frazil distribution at equilibrium. The rate of heat loss from the water surface, the surface renewal frequency, and the critical surface layer thickness determine whether the frazil will evolve toward a well-mixed equilibrium state or a layered state. The model provides a physical basis for understanding the transition between these states, consistent with existing empirical criteria and field data.

MP 3081

DIELECTRIC CONSTANT OF ICE AT 26.5-40 GHZ.

Koh, G., *Journal of applied physics*, May 15, 1992, 71(10), p.5119-5122, 7 refs.
46-3728

REMOTE SENSING, ELECTRICAL MEASUREMENT, ICE PHYSICS, RADIATION ABSORPTION, ICE ELECTRICAL PROPERTIES, DIELECTRIC PROPERTIES, MICROWAVES, WAVE PROPAGATION, ATTENUATION

The complex dielectric constant, $\epsilon = \epsilon' + i\epsilon''$, of ice at 26.5-40 GHz was determined using free-space measurement technique. A network analyzer-based system was used to measure the phase velocity and attenuation of a synthesized pulse propagating in bubble-free ice which was grown from distilled de-ionized water. Based on the phase velocity measurement, ϵ' was determined to be 3.155 and virtually independent of frequency. The loss factor in ice was observed to be frequency dependent so that ϵ'' increased from approximately 0.002 at the lower frequencies to 0.004 at the higher frequencies. No temperature dependence of ϵ' and ϵ'' was observed at ice temperatures of -2.5 and -15°C.

MP 3082

DIELECTRIC PROPERTIES OF WET AND DRY SNOW, 50 HZ-100 KHZ.

Camp, P.R., Labrecque, D.R., *Physics and chemistry of ice*. Edited by N. Maeno and T. Hondoh, Sapporo, Japan, Hokkaido University Press, 1992, p.156-

162, 6 refs.

46-3851

SNOWMELT, ELECTRICAL RESISTIVITY, WET SNOW, SNOW ELECTRICAL PROPERTIES, SNOW WATER CONTENT, DIELECTRIC PROPERTIES

Little information is available concerning the dielectric properties of wet or dry snow in the frequency range of the Debye dispersion in ice. This spectral region is interesting because here the dielectric behavior of the ice grains changes rapidly. Samples of six different snowstorms have been gathered and stored under similar conditions. Meltwater has been analyzed for conductivity, pH, and various ionic impurities. Dielectric properties have been measured for these snows, both dry and with various water contents. Water content was changed with minimum disturbance of the sample by melting a portion of the sample in place using resistive heating at 20 kHz.

MP 3083

MEASUREMENT OF DYNAMIC FRICTION OF ICE.

Itagaki, K., Huber, N.P., *Physics and chemistry of ice*. Edited by N. Maeno and T. Hondoh, Sapporo, Japan, Hokkaido University Press, 1992, p.212-218, 8 refs.
46-3860

SURFACE ROUGHNESS, SLEDS, METAL ICE FRICTION, MECHANICAL TESTS, ICE FRICTION, ICE SURFACE
A series of friction measurements was made between a rotating ice cylinder and bobsled runners of various roughness. The friction increased to a maximum and then dropped.

MP 3084

MATHEMATICAL MODEL ON THE STEADY GROWTH OF AN ICE LAYER IN FREEZING SOILS.

Nakano, Y., *Physics and chemistry of ice*. Edited by N. Maeno and T. Hondoh, Sapporo, Japan, Hokkaido University Press, 1992, p.364-369, 14 refs.
46-3883

SOIL WATER MIGRATION, MATHEMATICAL MODELS, SOIL FREEZING, FROZEN GROUND THERMODYNAMICS, ICE GROWTH, FREEZING FRONT

Recently, three distinct and representative hypotheses on the properties of the frozen fringe were evaluated mathematically and experimentally for a special case where the steady growth of an ice layer occurs in freezing soils. It was found that a hypothesis based on the independence of temperature and unfrozen water pressure in the frozen fringe was consistent with empirical data. The properties of the mathematical solution to the problem of steady growth of an ice layer under this hypothesis are presented.

MP 3085

EFFECT OF WIND ON FM-CW RADAR BACKSCATTER FROM A WET SNOWCOVER.

Koh, G., *IEEE transactions on geoscience and remote sensing*, May 1992, 30(3), p.619-621, 9 refs.
46-4067

MICROWAVES, SNOW AIR INTERFACE, SNOW COVER, RADAR ECHOES, BACKSCATTERING, SNOW WATER CONTENT, WET SNOW, SNOW EVAPORATION, WIND FACTORS

The most important factor affecting the microwave properties of a snowcover is the liquid water content (snow wetness). An FM-CW (26.5-40 GHz) radar has been used to investigate the influence of snow wetness on the magnitude of radar backscatter from a snowcover. The radar backscatter measurements from a wet snowcover on a windy day suggest that evaporative cooling due to the wind may reduce the amount of liquid water at the snowcover surface.

MP 3086

SNOW DISTRIBUTION AND HEAT FLOW IN THE TAIGA.

Sturm, M., *Arctic and alpine research*, May 1992, 24(2), p.145-152, 22 refs.
46-3974

SOIL TEMPERATURE, WATER STORAGE, WATERSHEDS, TAIGA, SNOW COVER DISTRIBUTION, SNOW COVER EFFECT, FOREST CANOPY, HEAT LOSS, TREES (PLANTS), TOPOGRAPHIC EFFECTS

The taiga forest covers vast areas of Alaska, Canada, Siberia, and Scandinavia. Winter lasts 6 to 8 months of the year, so the forest is snow covered more often than not. The trees of the forest intercept falling snow and cause it to become distributed in an uneven fashion. Beneath spruce trees (conifers), the snow cover is depleted and a bowl-shaped depression (a tree well) forms. Around aspen and birch (deciduous trees), a cone-shaped accumulation of snow forms. Postdepositional metamorphic processes accentuate this irregular snow distribution. The snow cover, in its undisturbed state, insulates and protects the underlying ground from the extremely low temperatures that occur during the boreal winter. However, this protection can be less effective when the snow cover has been modified by the trees. In this paper, the distribution of snow beneath the trees of the taiga forest is examined, and the effect of the uneven distribution on the winter heat loss from the ground is discussed.

MP 3087

COLD REGIONS RESEARCH AND ENGINEERING LABORATORY (CRREL).

Itagaki, K., *Seppyo*, Sep. 1991, 53(3), p.231-233, In Japanese.

46-1316

LABORATORIES, ORGANIZATIONS, RESEARCH PROJECTS

MP 3088

REVIEW, ANALYSIS AND VALIDATION OF SNOW-ONE-A TRANSMISSION DATA.

Gallery, W.O., et al, *Ann Arbor, MI, OptiMetrics, Inc.*, July 1985, 83p. + append., 15 refs.
46-3991

SNOWSTORMS, MILITARY RESEARCH, METEOROLOGICAL INSTRUMENTS, INFRARED RECONNAISSANCE, ANALYSIS (MATHEMATICS), SNOWFALL, SNOW OPTICS, ATMOSPHERIC ATTENUATION, VISIBILITY

MP 3089

THEORETICAL HEIGHTS OF BUOYANT CONVECTION ABOVE OPEN LEADS IN THE WINTER ARCTIC PACK ICE COVER.

Serreze, M.C., Maslanik, J.A., Rehder, M.C., Schnell, R.C., Kahl, J.D., Andreas, E.L., *Journal of geophysical research*, June 15, 1992, 97(C6), p.9411-9422, 39 refs.
46-4130

BUOYANCY, TEMPERATURE INVERSIONS, ATMOSPHERIC PHYSICS, POLYNOMIALS, AIR FLOW, CONVECTION, AIR TEMPERATURE, SEA ICE, ICE COVER EFFECT, BOUNDARY LAYER

A fetch-dependent boundary-layer model, driven by observed temperature sounding data, is used to examine theoretical heights of buoyant convection (H) above open leads in the wintertime pack ice of the central Arctic. Assuming wet adiabatic ascent with no entrainment or friction, H is estimated as the height at which the model-predicted equivalent potential temperature at saturation above a lead intersects with the same value of equivalent potential temperature at saturation derived from vertical sounding profiles. H increases with increasing lead width. For a 1000 m lead, the widest which can be reasonably expected for the central Arctic, the median value of H is approximately 1000 m, slightly below the median top of the low-level arctic temperature inversion layer. While H shows large variability, events of convection up to 4 km, as recently observed from lidar backscatter data, appear to be fairly rare. First, these events require an open lead of at least 10,000 m. Second, while H tends to be largest under conditions of low surface wind speed, low surface temperature, and a weak low-level temperature inversion, this combination appears to be atypical of arctic conditions. Third, while the meteorological conditions that should favor the development of open leads tend to minimize H , conditions favoring large H are also those in which any newly developed leads will quickly ice over.

MP 3090

PROCEEDINGS. VOL.4.

International Conference on Offshore Mechanics and Arctic Engineering, 11th, Calgary, Alberta, June 7-12, 1992, Ayorinde, O.A., ed, Sinha, N.K., ed, Sodhi, D.S., ed, Nixon, W.A., ed, New York, American Society of Mechanical Engineers, 1992, 422p., Refs. passim. For selected papers see 46-4133 through 46-4185.
46-4132

ICE BREAKING, ICE PRESSURE, SEA ICE, FOUNDATIONS, SOIL STRENGTH, SOIL PRESSURE, ICE SOLID INTERFACE, ICE COVER STRENGTH, ICE LOADS, ICE DEFORMATION, OFFSHORE STRUCTURES, PERMAFROST PRESERVATION

MP 3091

THERMAL DESIGN IN PERMAFROST REGIONS.

Zarling, J.P., Haynes, F.D., Lunardini, V.J., *International Conference on Offshore Mechanics and Arctic Engineering*, 11th, Calgary, Alberta, June 7-12, 1992. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, D.S. Sodhi, and W.A. Nixon, New York, American Society of Mechanical Engineers, 1992, p.113-121, 22 refs.
46-4147

SOIL AIR INTERFACE, COOLING SYSTEMS, HEAT PIPES, DUCTS, PERMAFROST BENEATH STRUCTURES, THERMAL ANALYSIS, ANALYSIS (MATHEMATICS), SOIL TEMPERATURE, PERMAFROST THERMAL PROPERTIES, PERMAFROST PRESERVATION, FOUNDATIONS
The essential thermal analyses required for foundation design in permafrost regions are presented. Equations are given for calculating the ground surface temperature and the temperature variation in the soil. Foundation designs on piles and on grade are discussed and design methods presented.

MP 3092

ASSESSMENT OF PREDICTION METHODS FOR THE THICKNESS OF THE ACTIVE LAYER IN PERMAFROST REGIONS.

Aziz, A., Lunardini, V.J., International Conference on Offshore Mechanics and Arctic Engineering, 11th, Calgary, Alberta, June 7-12, 1992. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, D.S. Sodhi, and W.A. Nixon, New York, American Society of Mechanical Engineers, 1992, p.131-138, 13 refs.

46-4148

PERMAFROST HEAT TRANSFER, SOIL AIR INTERFACE, SOIL TEMPERATURE, ANALYSIS (MATHEMATICS), PERMAFROST FORECASTING, PERMAFROST THERMAL PROPERTIES, ACTIVE LAYER, THAW DEPTH

Four methods of predicting the thickness of the active permafrost layer when the annual surface temperature variation follows a sinusoidal pattern are discussed: (1) a generalized Stefan method which incorporates the thawing index; (2) a two-region Neumann solution in which an equivalent constant surface temperature is used to simulate the sinusoidal variation; (3) a coupled integral equations approach; and (4) a two-term perturbation solution. The predictions of the Neumann and the perturbation solutions are closest to the finite element results, being within 1%. However, the perturbation method may be more useful in predicting the temperature variations in the active layer with time.

MP 3093

LABORATORY TESTS WITH A 37-M THERMOSYPHON IN SOIL.

Haynes, F.D., Zarling, J.P., Gooch, G.E., Zabilansky, L., International Conference on Offshore Mechanics and Arctic Engineering, 11th, Calgary, Alberta, June 7-12, 1992. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, D.S. Sodhi, and W.A. Nixon, New York, American Society of Mechanical Engineers, 1992, p.139-143, 14 refs.

46-4149

PERMAFROST BENEATH STRUCTURES, COOLING SYSTEMS, HEAT TRANSFER, PERMAFROST THERMAL PROPERTIES, CONDUCTION, PERMAFROST PRESERVATION, FOUNDATIONS, HEAT PIPES

Tests were conducted in the laboratory with a 37 m-long thermosiphon buried in soil to simulate actual field conditions. The evaporator section was horizontal and the finned condenser section was vertical. The thermosiphon had a device to return part of the condensate to the far end of the evaporator. Unit conductance values were obtained for wind speeds ranging from 0 to 2.4 m/s directed at the condenser section. These conductance values were used in a finite element analysis to determine if they were adequate for foundation design in permafrost regions.

MP 3094

FLOATING ICE BEAM IMPACT AGAINST A SLOPED STRUCTURE.

Coutermarsh, B.A., McGilvary, W.R., Sodhi, D.S., International Conference on Offshore Mechanics and Arctic Engineering, 11th, Calgary, Alberta, June 7-12, 1992. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, D.S. Sodhi, and W.A. Nixon, New York, American Society of Mechanical Engineers, 1992, p.173-181, 8 refs.

46-4155

BRIDGES, IMPACT TESTS, ICE DEFORMATION, ICE FRICTION, ICE PRESSURE, ICE SOLID INTERFACE, MATHEMATICAL MODELS, ICE LOADS, OFFSHORE STRUCTURES, ICE FLOES

Experiments were performed to measure the impact forces generated by free-floating ice beams striking a 45 deg sloped structure. Four beam lengths and impact velocities are used with a fixed beam width and thickness. A coupled fluid/solid finite element program was developed to model the impulse loads. The structure is modeled as a massless surface that can displace horizontally and vertically without rotation. The solid mechanics portion of the modelled ice is based on linear elastic beam theory, and includes rotary inertia and a static fluid foundation. The fluid dynamic portion assumes linear fluid inertial coupling for the fluid foundation. A fluid influence coefficient matrix is calculated and attached to the ice to account for the fluid foundation acceleration. The numerical model matches the experimental peak impact forces to within 10% to 33% for the majority of the beam lengths. The shortest beams considered appear to behave differently, and those experimental values were overpredicted by a factor of 2. Improvements in the predictions could be realized by including a mechanism for energy loss from the beam to the supporting fluid. The work also shows that structure stiffness greatly affects the impact force in ice/structure interactions.

MP 3095

INDENTATION TESTS USING UREA ICE AND SEGMENTED INDENTORS.

Sodhi, D.S., Chin, S.N., International Conference on Offshore Mechanics and Arctic Engineering, 11th,

Calgary, Alberta, June 7-12, 1992. Proceedings.

Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, D.S. Sodhi, and W.A. Nixon, New York, American Society of Mechanical Engineers, 1992, p.223-230, 16 refs.

46-4160

ICE BREAKING, UREA, ARTIFICIAL ICE, ICE MODELS, IMPACT TESTS, STRAIN TESTS, ICE LOADS, ICE COVER STRENGTH, ICE PRESSURE, ICE DEFORMATION

Segmented indentors were used to conduct indentation tests using urea model ice. Each segment of an indenter was supported on three load cells to enable measurement of force generated in that segment as a result of interaction with ice. Tests were conducted using 3, 5 or 7 segments. The range of ice thickness was between 40 and 81 mm, and the rate of indentation was between 2 and 400 mm/s. The results are presented as time-history plots of forces across each segment as well as the whole width of an indenter. The main result of these tests is that the effective pressure measured during tests at a low indentation rate was higher than that at high indentation rate. The force-time plots indicate that there was simultaneous failure of ice on all segments at low indentation rates, and that there was nonsimultaneous failure of ice at high rates of indentation. This behavior is attributed to brittle, flaking failure at high indentation rates. Spectral analysis of force data indicates that most of the power is contained at frequencies of less than 5 Hz. The peaks in the ice force records fit a Weibull probability distribution.

MP 3096

COMPOSTING PROCESS, DESIGN AND ANALYSIS IN COLD CLIMATE.

Ayorinde, O.A., Reynolds, C.M., International Conference on Offshore Mechanics and Arctic Engineering, 11th, Calgary, Alberta, June 7-12, 1992. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, D.S. Sodhi, and W.A. Nixon, New York, American Society of Mechanical Engineers, 1992, p.409-413, 11 refs.

46-4184

ROOFS, SNOW LOADS, COLD WEATHER PERFORMANCE, MILITARY FACILITIES, THERMAL ANALYSIS, HEAT TRANSFER, DECOMPOSITION, MATHEMATICAL MODELS, SOIL POLLUTION, WASTE TREATMENT, EXPLOSIVES

Composting has been investigated and field-demonstrated at the Louisiana Army Ammunition Plant (LAAP) by the Toxic and Hazardous Materials Agency of the U.S. Army Corps of Engineers as an alternative method of decontaminating explosives-contaminated soils and sediments in a warm environment. Soils and sediments were contaminated with explosive residues as a result of the manufacture, use and disposal of organic-based explosives at military bases and U.S. Army ammunition plants. A preliminary analysis was performed to evaluate the applicability of the LAAP warm-temperature compost design and operation methods to cold environment composting. The results of the analysis were quantitatively compared with the field observations of the winter compost operation at the Badger Army Ammunition Plant (BAAP) in Baraboo, WI.

MP 3097

THERMAL AND HYDRAULIC ANALYSIS OF A CHILLED PIPELINE RIVER CROSSING.

McGilvary, W.R., Carlson, R.F., International Conference on Offshore Mechanics and Arctic Engineering, 11th, Calgary, Alberta, June 7-12, 1992. Proceedings. Vol.4. Edited by O.A. Ayorinde, N.K. Sinha, D.S. Sodhi, and W.A. Nixon, New York, American Society of Mechanical Engineers, 1992, p.415-420, 13 refs.

46-4185

HEAT TRANSFER, FROZEN GROUND THERMODYNAMICS, ICE ACCRETION, ICE GROWTH, SOIL STABILIZATION, SOIL PRESSURE, MATHEMATICAL MODELS, UNDERGROUND PIPELINES, PIPELINE FREEZING, SOIL FREEZING, RIVER CROSSINGS

A buried, chilled pipeline surrounded by seeping groundwater is analyzed. The pipe is assumed to be located within a convection cell with the surface water temperature varying throughout the year. The volume and moment of the freeze bulb on the pipe are presented as functions of time. The heat transferred to the pipe is also presented. The pipe is assumed to be unable to move independently of the freeze bulb, and estimates of the maximum static horizontal and vertical forces transferred from the freeze bulb to the pipe are presented. Seismic forces associated with acceleration of the pipe and freeze bulb are not discussed in detail, although these may be significant. The accreted ice and soil mass is shown to attain a nearly symmetric shape in wintertime. For the cases investigated, the freeze bulb extends to the stream bed, which may lead to the formation of a dam, either by extension of the freeze bulb itself or by the capture of frazil ice. Upstream scour around the freeze bulb also may be a problem. In addition, there may be environmental impacts on local habitat. If the stream runs dry in the winter, afeis may form. In the summer, melting at the upstream portion of the freeze bulb leads to an asymmetric "teardrop" shape that gives the frozen mass a significant moment about the pipe center. The freeze bulb diminishes in

size and more heat is transferred to the pipe in summer than in winter.

MP 3098

SNOW AND GLACIER MAPPING IN ALPINE REGIONS WITH POLARIMETRIC SAR.

Shi, J.C., Dozier, J., Rott, H., Davis, R.E., International Geoscience and Remote Sensing Symposium (IGARSS '91), Espoo, Finland, Helsinki University of Technology, June 3-6, 1991. [Proceedings]. Remote sensing: global monitoring for Earth management, Vol.4, New York, Institute of Electrical and Electronics Engineers, Inc., 1991, p.2311-2314, 14 refs.

46-4266

ANALYSIS (MATHEMATICS), REMOTE SENSING, MAPPING, MICROWAVES, SYNTHETIC APERTURE RADAR, SNOW COVER DISTRIBUTION, GLACIERS, CLASSIFICATIONS

The objective of this study is to examine the capability of mapping snow and glacier in alpine regions using SAR radar imagery when topographic information is not available. The topographic effects on the received power for a resolution cell can be explained by the change in an illumination area and an incidence angle in a slant-range representation of SAR imagery. The specific polarization signature has been found to be relatively independent of both illumination area and incidence angle for a pixel resolution, and provides a suitable measurement data set for snow and glacier mapping in a high relief area. The results show that the C-band images of the enhancement factor, which is the ratio of synthesized image to the total power, provide the capability of discrimination between snow, glacier and rock regions.

MP 3099

ALKALINITY MEASUREMENTS IN WATER EXTRACTS OF CALCAREOUS SOILS.

Marion, G.M., Schlesinger, W.H., Fonteyn, P.J., *Soil Science Society of America. Journal*, Mar.-Apr. 1992, 56(2), p.598-600, 18 refs.

46-4293

SOLUBILITY, SOIL TESTS, SOIL CHEMISTRY, SOIL COMPOSITION

In soil carbonate solubility studies, it is usually assumed that total alkalinity is equal to inorganic-C alkalinity. Recent studies have raised questions about the validity of this assumption. This study reexamined previously published soil data from grass-oak (*Quercus* spp.) woodlands and deserts to test the hypothesis that total alkalinity is equal to inorganic-C alkalinity. Total alkalinity was measured with strong-acid titration, while inorganic-C alkalinity was calculated from pH and the partial pressure of CO₂ (pCO₂) measurements. Within the limits of error, calculated inorganic-C alkalinity was equal to measured total alkalinity. A recommendation was made for over-determining the state of experimental systems in solubility studies; this allows one to check the internal consistency of experimental measurements, equilibrium constants, and model assumptions.

MP 3100

CONFINED COMPRESSIVE STRENGTH OF HORIZONTAL FIRST-YEAR SEA ICE SAMPLES.

Richter-Menge, J.A., *Journal of offshore mechanics and arctic engineering*, Nov. 1991, Vol.113, p.344-351, 30 refs. For another version see 41-2422.

46-4294

STRAIN TESTS, COMPRESSIVE PROPERTIES, SEA ICE, ICE LOADS, ICE COVER STRENGTH, ICE PRESSURE, ICE DEFORMATION

A total of 110 first-year sea ice samples from Prudhoe Bay, AK, were tested in unconfined and confined constant strain rate compression. All of the tests were performed in the laboratory on a closed-loop electrohydraulic testing machine at -10 C. The confined tests were performed in a conventional triaxial cell ($\sigma_1 > \sigma_2 = \sigma_3$) that maintained a constant ratio between the radial and axial stress ($\sigma_2/\sigma_1 = \text{constant}$) to simulate true loading conditions. Three strain rates (0.1, 0.01, and 0.0001/s) and three σ_2/σ_1 ratios (0.25, 0.50, and 0.75) were investigated. This paper summarizes the field sampling and testing techniques and presents data on the effect of confinement on the compressive strength, initial tangent modulus, and failure strain of the ice.

MP 3101

MEASUREMENT OF HEAT LOSSES FROM HOT WATER HEAT DISTRIBUTION SYSTEMS.

Phetteplace, G.E., International District Heating and Cooling Association, 83rd Annual Meeting, Danvers, MA, June 12-17, 1992. Proceedings, Washington, D.C., 1992, p.301-315, 12 refs.

46-4295

HEAT TRANSFER, WATER PIPES, STEAM, MILITARY FACILITIES, COST ANALYSIS, HEAT LOSS, RADIANT HEATING

This paper describes two field projects underway at U.S. Army bases. At Fort Jackson, SC, a medium-temperature hot water heat

distribution system is being monitored. Three different types of system constructions have been instrumented: pipes enclosed in a shallow concrete trench, steel conduit with supply and return pipes in common conduit, and separate steel conduits for supply and return pipes. At Ft. Irwin, CA, a low-temperature hot water system is being monitored. Two sites have been instrumented on this direct buried system that consists of steel carrier pipes insulated with polyurethane foam protected by a fiberglass jacket. The heat losses from these systems are being monitored.

MP 3102
ENGINEERING ASPECTS OF METAL-WASTE MANAGEMENT.

Iskandar, I.K., ed, Selim, H.M., ed, Chelsea, MI, Lewis Publishers, 1992, 231p., Proceedings of a workshop that was part of the International Conference on Metals in Soils, Waters, Plants, and Animals, Orlando, FL, Apr. 30-May 3, 1990. Refs. passim. For selected paper see 46-4338.
46-4337
METALS, SOIL MICROBIOLOGY, STATISTICAL ANALYSIS, MATHEMATICAL MODELS, WASTE TREATMENT, SOIL POLLUTION, SOIL CHEMISTRY

MP 3103
MICROWAVE DIGESTION PROCEDURES FOR CHARACTERIZING METAL CONTAMINATED SOILS: APPLICATIONS, LIMITATIONS AND PROJECTED CAPABILITIES.

Reynolds, C.M., Engineering aspects of metal-waste management. Edited by I.K. Iskander and H.M. Selim, Chelsea, MI, Lewis Publishers, 1992, p.49-61, 50 refs.
46-4338
METALS, SOIL TESTS, CHEMICAL ANALYSIS, MICROWAVES, SOIL POLLUTION, SOIL CHEMISTRY

MP 3104
ARCTIC RESEARCH OF THE UNITED STATES, VOL.6.

U.S. Interagency Arctic Research Policy Committee, Myers, C.E., ed, Bowen, S.L., ed, Cate, D.W., ed, Valliere, D.R., ed, Washington, D.C., Spring 1992, 136p.
46-4381
LEGISLATION, COST ANALYSIS, INTERNATIONAL COOPERATION, MEETINGS, RESEARCH PROJECTS, ORGANIZATIONS

MP 3105
LOW-TEMPERATURE WATER FOR HEAT DISTRIBUTION SYSTEMS.

Phetteplace, G.E., United States Army Corps of Engineers Electrical and Mechanical Engineering Conference, Dallas, TX, July 14-17, 1992, Dallas, 1992, p.139-145, 6 refs.
46-4383
HEAT TRANSFER, HEAT LOSS, MILITARY FACILITIES, COST ANALYSIS, RADIANT HEATING, WATER PIPES

MP 3106
U.S. RESEARCH IN ICE MECHANICS: 1987-1990.

Richter-Menge, J.A., *Cold regions science and technology*, June 1992, 20(3), p.231-246, Refs. p.242-246.
46-4443
MECHANICAL PROPERTIES, MICROSTRUCTURE, MECHANICAL TESTS, ICE MECHANICS, SEA ICE, RESEARCH PROJECTS, BIBLIOGRAPHIES, ICE SOLID INTERFACE, ICE MODELS
This compilation of U.S. ice mechanics investigations over 1987-1990 focuses on efforts that support the development of an understanding of sea ice interaction. Both ice-structure and ice-ice interaction studies have been included in hopes that insights from one area will complement developments in the other. The work discussed in the area of ice-structure interaction was intentionally limited to lateral movement of the ice against a vertical structure. It is these results that can be most easily extended to ice-ice interaction events.

MP 3107
PERFORMANCE OF A THERMOSYPHON WITH A 37 METER-LONG, HORIZONTAL EVAPORATOR.

Haynes, F.D., Zarling, J.P., Gooch, G.E., *Cold regions science and technology*, June 1992, 20(3), p.261-269, 12 refs.
46-4445
SOIL STABILIZATION, DESIGN, ICE GROWTH, HEAT SINKS, PERMAFROST PRESERVATION, TEMPERATURE CONTROL, PIPES (TUBES), REFRIGERATION, SIMULATION, PERMAFROST HEAT TRANSFER, THERMAL CONDUCTIVITY, COLD WEATHER PERFORMANCE

Laboratory tests were conducted on a thermosyphon with a 37 m long horizontal evaporator. This evaporator section was placed in a water tank so that the rate of ice growth on it could be determined. Unit conductance values were calculated for wind speeds of 0 to 5.4 m/s applied to the condenser section. Use of these conductance values in a finite element analysis indicated that thermosyphons with horizontal evaporators and condensate return devices were adequate for many foundation designs in permafrost regions.

MP 3108
SEAFLOOR TEMPERATURE AND CONDUCTIVITY DATA FROM STEFANSSON SOUND, ALASKA.

Sellmann, P.V., Delaney, A.J., Chamberlain, E.J., Dunton, K.H., *Cold regions science and technology*, June 1992, 20(3), p.271-288, 11 refs.
46-4446

SUBSURFACE INVESTIGATIONS, SOIL COMPACTION, SEASONAL VARIATIONS, OCEAN BOTTOM, LIQUID SOLID INTERFACES, BOTTOM SEDIMENT, FREEZING POINTS, WATER TEMPERATURE, SALINITY, TEMPERATURE MEASUREMENT, ELECTRICAL RESISTIVITY
Overconsolidated sediments, seasonal seafloor freezing, and ice-bonded permafrost, unique features in shallow arctic coastal waters, are related to low seawater temperatures and varying salinities. Seabed temperatures can be less than -1.0 C for much of the year, with noticeable warming occurring only during the summer months. Observations from recent deployment of three instruments in Stefansson Sound and data from an earlier deployment, which included sites in Harrison Bay, showed decreasing mean annual seafloor temperatures with increasing water depth, ranging from -0.9 C in 4.4 m of water to -1.6 C in 14 m of water. Salinities also varied seasonally, with noticeable freshening developing during the summer and high uniform values occurring during the winter. Periodic temperature and salinity measurements at sites in Stefansson Sound, made during Aug. 1987 and Aug. 1989, also helped verify the data obtained with the seabottom instruments. Seasonal freezing of the seabed can begin in late September and may noticeably change its engineering properties. In areas of coarse-grained sediments, ice bonding and strengthening of the seabed can result. In areas of fine-grained sediments it appears that seasonal freezing of the seafloor can cause overconsolidation of the seabed sediments. This densification process can result in a significant permanent increase in strength.

MP 3109
CONSTRUCTION IN AREAS OF EXTREME CLIMATIC AND COMPLEX GEOLOGICAL CONDITIONS. Office of the Chief of Engineers, U.S. Army Corps of Engineers, 6 Apr., 1986, 91p., Meeting of Working Group 10.5 of the U.S./U.S.S.R. Joint Commission on Cooperation in the Field of Housing and Other Construction, 10-20 March 1986, Leningrad and Yakutsk, U.S.S.R.
46-3527

CONCRETE PILES, PILE LOAD TESTS, MEETINGS, INTERNATIONAL COOPERATION, COLD WEATHER CONSTRUCTION, FOUNDATIONS, BUILDINGS, PERMAFROST BENEATH STRUCTURES

MP 3110
NUMERICAL SIMULATIONS OF A COMPACT CONVERGENT SYSTEM OF ICE FLOES.

Hopkins, M.A., Hibler, W.D., III, *Annals of glaciology*, 1991, Vol.15, Symposium on Ice-Ocean Dynamics and Mechanics, Hanover, NH, Aug. 26-31, 1990. Proceedings, p.26-30, 7 refs.
46-1708
ICE MECHANICS, PACK ICE, ICE FRICTION, ICE MODELS, MATHEMATICAL MODELS, ICE FLOES, ICE DEFORMATION, DRIFT

MP 3111
ON THE RIDGING OF A THIN SHEET OF LEAD ICE.

Hopkins, M.A., Hibler, W.D., III, *Annals of glaciology*, 1991, Vol.15, Symposium on Ice-Ocean Dynamics and Mechanics, Hanover, NH, Aug. 26-31, 1990. Proceedings, p.81-86, 9 refs.
46-1715
SEA ICE, MATHEMATICAL MODELS, ICE MODELS, ICE FLOES, PRESSURE RIDGES, ICE DEFORMATION, ICE OPENINGS

MP 3112
EXPERIMENTAL FRACTURE MECHANICS OF ASPHALTIC CONCRETES IN THE LINEAR ELASTIC REGIME.

Jiménez Hamann, F.N., Worcester, MA, Worcester Polytechnic Institute, 1992, 61p., M.S. thesis. 16

refs.

46-4520

BITUMINOUS CONCRETES, FROST RESISTANCE, CRACKING (FRACTURING), COLD STRESS, STRAIN TESTS, CONCRETE PAVEMENTS, CONCRETE STRENGTH, CONCRETE FREEZING

MP 3113
SEA SPRAY AND THE TURBULENT AIR-SEA HEAT FLUXES.

Andreas, E.L., *Journal of geophysical research*, July 15, 1992, 97(C7), p.11,429-11,441, 76 refs.
46-4553

ANALYSIS (MATHEMATICS), WIND FACTORS, CLOUD PHYSICS, SEA SPRAY, AIR WATER INTERACTIONS, AIR TEMPERATURE, DROPS (LIQUIDS), HEAT FLUX, TURBULENT BOUNDARY LAYER, MOISTURE TRANSFER

Heat and moisture carried by sea spray have long been suspected of contributing to the air-sea fluxes of sensible and latent heat. Using time scales that parameterize how long sea spray droplets reside in the air and how quickly they exchange heat and moisture with their environment, the author estimates sea spray contributions to the air-sea heat fluxes. To make these estimates, a new sea spray generation function that predicts more realistic spume production than earlier models is developed. Spray droplets with initial radii between 10 and 300 microns contribute most to the heat fluxes; the vast majority of these are spume droplets. The modeling not only demonstrates how spray droplets participate in the air-sea heat exchange but also confirms earlier predictions that the heat carried by sea spray (especially the latent heat) is an important component of the air-sea heat balance. In cited examples, the maximum magnitude of the spray latent heat flux for a 20 m/s wind is 170 W/sq m; the maximum spray sensible heat flux is 33 W/sq m. For winds over 10 m/s, the spray latent heat flux is usually a substantial fraction of the interfacial (or turbulent) latent heat flux (estimated from the bulk-aerodynamic equations), and will thus confound measurements of the air-sea transfer coefficient for latent heat.

MP 3114
GROWTH, STRUCTURE AND PROPERTIES OF ANTARCTIC SEA ICE.

Ackley, S.F., *IAHS publication*, 1991, No.208, Glaciers-ocean-atmosphere interactions. Edited by V.M. Kotliakov, A. Ushakov, and A. Glazovskii, p.105-117, 20 refs.
46-4610

FRAZIL ICE, SEA ICE, PACK ICE, ICE GROWTH, ICE STRUCTURE, ICE COVER THICKNESS, AIR ICE WATER INTERACTION, ICE EDGE, DRIFT, ANTARCTICA—WEDDELL SEA

The Weddell Gyre region is one of the more complex areas of sea ice processes in Antarctica. In the western part of the region, the pack ice persists year-round, caused by a vigorous generation and circulation of the ice, controlled by the atmospheric and ocean current forcing that is turned northward by the topographic boundary of the Antarctic Peninsula. The dynamical character of the pack ice affects the ice thickness characteristics, with the oldest, thickest ice appearing in the northwest outflow region of the western pack ice. In the eastern part, the pack is seasonal rather than perennial. The primary origin of the pack ice (0.6 m of mean ice thickness) is the rapid formation of pancake ice, controlled by the temperature and ocean wave regime at the ice edge during the advance period. (Auth.)

MP 3115
ENGINEERING DESIGN CHOICES FOR GREAT LAKES SMALL CRAFT HARBORS USING A WINTER CONDITIONS CLASSIFICATION SYSTEM.

Wortley, C.A., *IAHR Symposium on Ice*, 11th, Banff, Alberta, Canada, June 15-19, 1992. Proceedings. Vol.1, 1992, p.41-48, 3 refs.
46-4917

LAKE ICE, ICE CONDITIONS, DOCKS, SITE SURVEYS, DATA PROCESSING, PORTS, COLD WEATHER OPERATION, ICE CONTROL

To aid designers in selecting among choices for the design of docks and other harbor structures, a winter Conditions Classification System was presented at the 10th Ice Symposium. The conditions are ice thickness, water level fluctuation, water and air temperatures, winter duration, snowfall, ice sheet confinement and integrity, and miscellaneous site specific conditions. The classifications are mild, average and severe, and represent conditions that range between not too significant to very significant for design purposes. This paper presents a matrix of design choices which correspond with classified winter conditions at a given site. The small craft harbor design elements are: structural dockage systems, floating dockage systems, and removable dockage systems supplemented by ice control measures. Making the best engineering design choices for given winter conditions will result in safe, economical and long-lasting small craft harbor facilities.

MP 3116

FIELD TEST OF A SURFACE-HEATED TRASH RACK TO PREVENT FRAZIL ICE BLOCKAGE.

Daly, S.F., Haynes, F.D., Garfield, D.E., Clark, C.H., IAHR Symposium on Ice, 11th, Banff, Alberta, Canada, June 15-19, 1992. Proceedings. Vol.1, 1992, p.71-77, 8 refs.

46-4920

WATER INTAKES, ELECTRIC POWER, ELECTRIC HEATING, RIVER ICE, FRAZIL ICE, ICE PREVENTION

The concept of heating only the leading edge of trash rack bars to efficiently prevent frazil ice blockage has been investigated. Proof-of-concept tests conducted in a laboratory flume proved to be successful in preventing blockage by frazil ice. A field test was then made at a small (143-kw) hydro plant. This field test was successful in greatly reducing frazil ice blockage. The total electrical power supplied was only 2.8 kw, or 0.26 kw/sq ft.

MP 3117

DYNAMIC ANALYSIS OF ICE FLOE UNDER-TURNING STABILITY.

McGillvary, W.R., Coutermarsh, B.A., IAHR Symposium on Ice, 11th, Banff, Alberta, Canada, June 15-19, 1992. Proceedings. Vol.1, 1992, p.489-502, 10 refs.

46-4958

ICE FLOES, ICE COVER STRENGTH, ICE BOTTOM SURFACE, WATER PRESSURE, ICE CONTROL, ICE MODELS, MATHEMATICAL MODELS, RIVER ICE, RIVER FLOW, ICE WATER INTERFACE, ICE COVER EFFECT

In order to estimate the ice floe capture efficiency of a river ice cover, an underturning stability criteria is required for each characteristic floe geometry. In the current work, the measured hydrodynamic pressure distribution on the bottom of a single model ice floe is used to estimate the dynamic stability at three thickness to depth ratios. The energy-based analysis details the conditions required for instability, metastability, and stability. The results are shown to compare favorably to existing stability criteria. At all three thickness to depth ratios, the effect of block rotational inertia has the effect of reducing the Froude number by 5% to 10% over a completely static stability criterion.

MP 3118

IN-SITU MEASUREMENT OF THE PERMEABILITY OF FRAZIL ICE.

White, K.D., Lawson, D.E., IAHR Symposium on Ice, 11th, Banff, Alberta, Canada, June 15-19, 1992. Proceedings. Vol.2, 1992, p.622-632, 14 refs.

46-4969

PERMEABILITY, SEEPAGE, BOTTOM ICE, BOREHOLES, FRAZIL ICE, RIVER ICE, ICE WATER INTERFACE

The intrinsic permeability of a frazil deposit can be used to describe its flow capacity and structure. Because of the nature of frazil ice, an in-situ test is desirable when determining this parameter in natural frazil deposits. This paper describes the application of a borehole dilution test to determine seepage velocity, which is then used to calculate intrinsic permeability and estimate porosity. Seepage velocities ranged from .00029 to .00598 cm/s (.00256 cm/s average), and average intrinsic permeability was .000275/sq cm. Porosities for ϕ_{10} grain sizes of 0.5 and 3.5 mm were 82.9 and 47.9%, respectively. Seepage velocity and porosity data are also compared to data from laboratory borehole dilution tests, previous in-situ groundwater flow meter measurements at the same site, and permeameter tests on remolded samples.

MP 3119

ICE-STRUCTURE INTERACTION WITH SEGMENTED INDENTORS.

Sodhi, D.S., IAHR Symposium on Ice, 11th, Banff, Alberta, Canada, June 15-19, 1992. Proceedings. Vol.2, 1992, p.909-929, 46 refs.

46-4991

ICE COVER STRENGTH, IMPACT TESTS, PENETRATION TESTS, MATHEMATICAL MODELS, ICE SOLID INTERFACE, ICE LOADS, ICE PRESSURE, ICE DEFORMATION

Experimental work on ice-structure interaction is reviewed. The review includes small-scale and medium-scale indentation tests conducted to understand this interaction and to measure the effective pressures at different speeds and contact areas. Different modes of ice failure have been identified, such as ductile failure, ductile flaking and brittle flaking. Experiments to understand brittle flaking were conducted in the laboratory to observe the ice-structure interaction and to measure pressure in different parts of the indenter. It was found that the contact between the indenter and the ice failing during brittle flaking is over a small area of contact. Such small areas of contact were also observed in the ship-ice interaction. To compare results of indentation tests done at different scales, it is suggested that a similarity principle from "replica" modeling be adopted. In replica modeling, the indentation tests are done at a scale smaller than full-scale, using the same material and the same indentation speed as in full scale. Using this similarity principle, the effective pressure measured in small-scale indentation tests in freshwater ice is found to be in the range of pressures measured on large structures in the field.

MP 3120

OBSERVATIONS OF STRESS IN ARCTIC PACK ICE.

Perovich, D.K., Jones, K.F., Tucker, W.B., IAHR Symposium on Ice, 11th, Banff, Alberta, Canada, June 15-19, 1992. Proceedings. Vol.2, 1992, p.979-990, 20 refs.

46-4994

ICE PRESSURE, THERMAL STRESSES, STRAIN MEASURING INSTRUMENTS, MATHEMATICAL MODELS, PACK ICE, ICE LOADS, ICE DEFORMATION, ICE COVER STRENGTH

Measurements of ice stresses were made from Sep. through Nov. in first-year and multiyear sea ice in the Eastern Arctic ice pack. Observed stresses were typically less than 50 kPa, with peak values reaching 400 kPa in young ice and 150 kPa in the interior of a multiyear floe. The largest stresses were always observed in the upper half of the ice sheet. Three sources of ice stress were identified in the multiyear record: 1) stresses induced by temperature changes, 2) stresses resulting from inertial oscillations of the ice pack, and 3) stresses occurring during deformation events. Stresses in the first year ice were caused by inertial motions and by deformation. Under certain loading conditions, strong coupling was evident between the thin first-year ice and the adjacent multiyear floes, with stresses being greatest in the young ice and rapidly attenuating away from the floe edge in the multiyear ice. The stress field in the ice pack was complex and showed great spatial and temporal variability. A two-dimensional finite element model (ABAQUS) was used to interpret the point stress measurements and to estimate the stress distribution in the ice associated with unidirectional loading.

MP 3121

COMPRESSIVE STRENGTH OF FRAZIL SEA ICE.

Richter-Menge, J.A., IAHR Symposium on Ice, 11th, Banff, Alberta, Canada, June 15-19, 1992. Proceedings. Vol.2, 1992, p.1065-1074, 12 refs.

46-5000

SEA ICE, ICE DEFORMATION, COMPRESSIVE PROPERTIES, BRINES, STRAIN TESTS, FRAZIL ICE, ICE COVER STRENGTH, ICE PRESSURE, ICE LOADS, ANTARCTICA—WEDDELL SEA

Unconfined, uniaxial compressive strength tests were performed on frazil sea ice samples collected in the Weddell Sea. The tests were done at constant strain rates ranging from .01 to .00001/s and temperatures of -5 and -10 C. These conditions covered the brittle-to-ductile transition of this ice type. Results of the tests are presented and the compressive strength of the frazil samples is compared to the strength of transversely isotropic columnar saline ice loaded perpendicular to the growth direction. This analysis indicates that the strength of the frazil and columnar ice is comparable at a given porosity. The author discusses this finding with respect to the variations in the structural characteristics of each ice type. In particular, the influence of grain size and the spacing of brine inclusions are considered. (Auth.)

MP 3122

ICE PHYSICS AND MICROMECHANICS: A REVIEW OF SELECTED TOPICS.

Cole, D.M., IAHR Symposium on Ice, 11th, Banff, Alberta, Canada, June 15-19, 1992. Proceedings. Vol.2, 1992, p.1087-1099, 59 refs.

46-5002

ICE LOADS, ICE STRENGTH, ICE MICROSTRUCTURE, DISLOCATIONS (MATERIALS), INTERNAL FRICTION, ICE DEFORMATION, ICE PRESSURE, ICE CREEP, ICE CRACKS

This paper focuses on recent theoretical and experimental developments in laboratory studies of ice physics and micromechanics. Topics of interest include progress in the observation and interpretation of dislocation-based processes and their relationship to mechanical behavior, electrical effects, microcrack nucleation, anelasticity, internal friction, creep and pressure effects. Recent experimental developments are discussed and their impact on current theories are evaluated. Relevant contributions include crack nucleation studies, techniques for reversed direct-stress testing, fatigue crack growth studies and the direct observation of dislocations. Research findings are assessed in terms of the insight they provide regarding the physical processes that underlie mechanical behavior. Areas where recent findings are at odds with established lines of thought receive particular attention.

MP 3123

LINKS BETWEEN SNOWPACK PHYSICS AND SNOWPACK CHEMISTRY.

Davis, R.E., NATO Advanced Science Institutes. Series G, 1990, Vol.28, NATO Advanced Research Workshop on Processes of Chemical Change in Snowpacks, Maratea, Italy, July 23-27, 1990. Proceedings. Seasonal snowpacks—processes of compositional change. Edited by T.D. Davies et al, p.115-138, 60 refs.

46-5015

ICE WATER INTERFACE, SOLUTIONS, SNOW COVER

STABILITY, METAMORPHISM (SNOW), SNOW PHYSICS, SNOWMELT, CHEMICAL COMPOSITION, WATER FLOW, SNOW HYDROLOGY, LEACHING

This paper includes two major parts. Theories and observations of dry and wet snow metamorphism are surveyed with discussions on the location and migration of chemical species, followed by a review of observations of heterogeneous water flow and some attempts to model percolation in two modes. Next, the theory of water flow coupled to solute transport is presented for homogeneous flow in a homogeneous snow layer. A method accounting for water flow in multiple paths is described, summarizing the difficulties of coupling solute flow. Both the discussion of metamorphism and water flow in snow conclude with comments on the disparity between theory and measurements, especially as it relates to the effects of stratigraphy of snow covers. The review here does not cite all of the work in this field, but summarizes what this author considers to be the important concepts and gaps in understanding the links between snow pack physics and chemistry.

MP 3125

SPECIMEN PREPARATION FOR ICE RESEARCH.

Garcia, N.B., *Cold regions science and technology*, Apr. 1985, 10(3), p.273-275, 4 refs.

46-5286

ICE MAKERS, ARTIFICIAL FREEZING, LABORATORY TECHNIQUES, ARTIFICIAL ICE, ICE SAMPLING

MP 3126

INSTRUCTIONS FOR MAKING SNOW OBSERVATIONS.

U.S. Army Corps of Engineers. Snow, Ice, and Permafrost Research Establishment, *SIPRE instruction memorandum*, 1953, No.1, 8p.

46-5325

SNOW HARDNESS, SNOW CRYSTAL STRUCTURE, SNOW SURVEYS, SNOW COVER STRUCTURE, SNOW SURFACE

MP 3127

VIBRATION IN PERCUSSIVE DRILL RODS.

Dutta, P.K., International Conference on Vibration Problems of Mathematical Elasticity and Physics, 1st, Jaipur, India, Oct. 20-23, 1990. Proceedings. Edited by M.M. Bannarjee and P. Biswas, Jaipur, A.C. College, 1990, 13p., 12 refs.

46-5330

VIBRATION, NOISE (SOUND), SHOCK WAVES, STRESSES, MATHEMATICAL MODELS, ROCK DRILLING, PERCUSSION DRILLING, DAMPING

MP 3128

THEORY OF STRENGTH DEGRADATION OF UNIDIRECTIONAL FIBER COMPOSITES AT LOW TEMPERATURE.

Dutta, P.K., Industry-University Advanced Materials Conference II, Denver, CO, Mar. 6-9, 1989. Proceedings. Edited by F.W. Smith, Golden, CO, Colorado School of Mines, Advanced Materials Institute, 1989, p.647-662, 19 refs.

46-5331

RESINS, POLYMERS, TENSILE PROPERTIES, COLD WEATHER PERFORMANCE, TEMPERATURE EFFECTS, MATHEMATICAL MODELS, COMPOSITE MATERIALS, LOW TEMPERATURE TESTS, COLD STRESS

Recent studies have shown that unidirectional polymeric composites, when loaded at low temperature in the direction of the fibers, fail at lesser loads than when loaded at room temperature. Evidence of such strength reduction in the cold has been observed in fiberglass-epoxy, carbon-epoxy and Kevlar-epoxy composites. A hypothesis is put forward based on the development of stress concentrations in fibers embedded in the cold hardened matrix. At room temperature the resin is relatively less stiff; it tends to allow the wavy fibers to align in the direction of loading and share the load uniformly. At low temperature the resin is stiffer; since the fibers cannot align, the waviness persists and local stress concentration causes the fibers to fail.

MP 3129

OBSERVATIONS OF ACOUSTIC SURFACE WAVES PROPAGATING ABOVE A SNOW COVER.

Albert, D.G., International Symposium on Long-Range Sound Propagation, 5th, Milton Keynes, England, May 24-26, 1992, Washington, D.C., National Aeronautics and Space Administration, 1992, 7p., 16 refs.

47-450

SNOW COVER EFFECT, SOUND TRANSMISSION, SOUND WAVES, SNOW ACOUSTICS, SNOW AIR INTERFACE

For the first time surface acoustic waves have been experimentally observed propagating above a seasonal snow cover. Blank

pistol shots were fired 1 m above the snow as the source of acoustic impulses; acoustic waveforms were measured by a vertical array of six microphones at heights between 0.1 and 4.75 m at a location 60 m away from the source. The snow cover was 0.20 m thick with an average density of 200 kg/cu m and crystal sizes of 0.5 to 1 mm. The peak pressures measured at all of the microphones were markedly reduced compared with pressures measured when a snow cover was not present because of the well-known absorptive effect of snow. Waveforms recorded near the surface displayed a strong, low-frequency "tail" following the initial impulsive arrival from the shot. This tail was found to decay exponentially with height above the surface, a diagnostic feature of surface waves, with a measured attenuation coefficient 0.5/m. Waveforms calculated using Attenborough's model of ground impedance are shown to agree with the observed waveforms when an assumed effective flow resistivity of 20 kN/s/m exp -4 is used for the snow.

MP 3130 RETARDERS KEEP MOISTURE, THE ENEMY WITHIN, AT BAY.

Tobiasson, W., *RSI: Roofing/siding/insulation*, Aug. 1990, p.34-35, 38, 40.

47-451

MOISTURE, ROOFS, WATERPROOFING, VAPOR BARRIERS

MP 3131 COMMENT ON "FORMIC AND ACETIC ACIDS IN COASTAL NORTH CAROLINA RAINWATER".

Hewitt, A.D., Cragin, J.H., *Environmental science & technology*, Aug. 1992, 26(8), p.1666, 3 refs.

47-452

WATER POLLUTION, RAIN, ENVIRONMENTAL PROTECTION, AIR POLLUTION, WATER TREATMENT

MP 3132 COMMENT ON "A STUDY OF THE LINEAR RANGES OF SEVERAL ACID DIGESTION PROCEDURES".

Hewitt, A.D., Cragin, J.H., *Environmental science & technology*, Sep. 1992, 26(9), p.1848, 3 refs.

47-453

SOIL CHEMISTRY, ENVIRONMENTAL PROTECTION, SOIL POLLUTION, WASTE TREATMENT

MP 3133 COMMENT ON "ACID DIGESTION FOR SEDIMENTS, SLUDGES, SOILS, AND SOLID WASTES. A PROPOSED ALTERNATIVE TO EPA SW 846 METHOD 3050".

Hewitt, A.D., Cragin, J.H., *Environmental science & technology*, May 1991, 25(5), p.985-986, 15 refs.

47-454

SLUDGES, ENVIRONMENTAL PROTECTION, SOIL POLLUTION, WASTE TREATMENT

MP 3134 THERMAL EFFECTS DUE TO AIR FLOW AND VAPOR TRANSPORT IN DRY SNOW.

Albert, M.R., McGilvary, W.R., *Journal of glaciology*, 1992, 38(129), p.273-281, 21 refs.

47-468

CONVECTION, ANALYSIS (MATHEMATICS), FORECASTING, THERMAL REGIME, SNOW AIR INTERFACE, SNOW THERMAL PROPERTIES, SNOW TEMPERATURE, VAPOR TRANSFER, HEAT TRANSFER, SUBLIMATION, TEMPERATURE EFFECTS

The thermal effects of air flow forced through a snow sample are investigated numerically. A new method for calculating vapor transport in snow is presented which allows for the determination of the effects of sublimation. In this method, the snow is not assumed to be saturated with water vapor. Results of the model show very good agreement with analytical and experimental results. It is demonstrated that the heat transfer associated with vapor transport is significant in the determination of the overall temperature profile of a ventilated snow sample, but that the major effects are controlled by the heat carried by the dry air flow through the snow and heat conduction due to the temperatures imposed at the boundaries. \$04 \$Journal of glaciology

MP 3135 ICE-BLISTER OBSERVATIONS ON GLACIERS, SEA ICE AND RIVERS.

Kovacs, A., *Journal of glaciology*, 1992, 38(129), p.314-316, 15 refs.

47-473

SURFACE PROPERTIES, ICE SHEETS, ICING, ICE SURFACE, FROST MOUNDS, FROST ACTION

In this letter, the author offers an elaboration of information concerning ice-blister location and morphology presented in a previous paper of the journal. This feature is not confined to glacier surfaces, but has been reported on sea ice and river surfaces as well. Details concerning the distribution and formation of ice-

blisters are also related.

MP 3136 WINTER OPERABILITY: EQUIPMENT PROBLEMS AND THEIR REMEDIES.

Diemand, D., *Journal of cold regions engineering*, Sep. 1992, 6(3), p.124-137, 23 refs.

47-587

ADMIXTURES, PLASTICS, TEMPERATURE EFFECTS, MOTOR VEHICLES, COUNTERMEASURES, CONSTRUCTION EQUIPMENT, COLD WEATHER OPERATION, LUBRICANTS, HEATING, DESIGN

With increased construction activities in cold regions, many remedies for low-temperature problems have been developed, and active research on new methods and improvements of existing techniques continues. Recent research in this area has included lubricants, plastics and elastomers, and heaters for the engine and other components. The recent development of synthetic hydrocarbon and silicone lubricants has alleviated many problems in the cold, and the current proliferation of plastics, elastomers, and composites has yielded promising materials for low-temperature use. Electric immersion heaters and fuel-fired units are commonly used for engine heating; research in the area of engine and equipment heating has resulted in the development of sophisticated programmable units as well as new devices using thermoelectric technology and latent-heat storage.

MP 3137 COLD WEATHER COUNTERMOBILITY ANALYSIS: MINE, EXPLOSIVE, CONSTRUCTED AND EXPEDIENT OBSTACLES.

Richmond, P.W., *Mobility/Counter-mobility Simulation and Analysis Symposium*, Apr. 8-10, 1992, 1992, 7p., 15 refs.

47-603

MILITARY RESEARCH, MINES (ORDNANCE), EXPLOSIVES, COLD WEATHER OPERATION, MILITARY OPERATION, TANKS (COMBAT VEHICLES)

The cold weather environment and its effect on mobility/counter-mobility operations must be understood and exploited by winter battlefield commanders. Simulations, computerized planning tools and war game models should offer the user an opportunity to exercise any given scenario in a winter or transitional environment. The winter, and especially the transitional environment, is easy to overlook, and the required data are difficult to obtain, for a number of reasons. This paper describes data and algorithms and the author's perceptions of these operations under winter conditions. Specifically, mine warfare and the use of constructed, explosive and expedient obstacles on the winter battlefield are discussed.

MP 3138 CONCRETE AT SUBFREEZING TEMPERATURES.

Korhonen, C.J., Cortez, E.R., Charest, B.A., *Materials Engineering Congress*, Atlanta, GA, Aug. 10-12, 1992. Proceedings. Materials: performance and prevention of deficiencies and failures. Edited by T.D. White, New York, American Society of Civil Engineers, 1992, p.382-397, 7 refs.

47-606

CONCRETE ADMIXTURES, ANTIFREEZES, WINTER CONCRETING, CONCRETE FREEZING, CONCRETE STRENGTH

Temperature affects the rate at which portland cement concrete develops strength. Below about 20 C, strength gain is retarded, whereas at higher temperatures it is accelerated. Strength gain is essentially stopped at temperatures below -5 C because water that otherwise would be available for hydration freezes. A series of chemicals was tested for the ability to promote strength gain of concrete at 20, -5, -10, and -20 C. The results show that low-temperature strength gain of concrete containing certain chemicals can be comparable to that of additive-free concrete cured at normal temperature. The best admixtures were those that depressed the freezing point of the mix water and accelerated the hydration of cement.

MP 3139 WHAT IS BEING DONE TO REDUCE ICE JAM DAMAGES.

Gruntfest, E., Multi-objective approaches to floodplain management, Madison, WI, Association of State Floodplain Managers, 1992, p.243-245, 4 refs. Proceedings of the 16th annual conference, Grand Rapids, MI, May 18-22, 1992.

47-622

RIVER ICE, COST ANALYSIS, DATA PROCESSING, ICE JAMS, ICE CONTROL, FLOOD CONTROL

MP 3140 ICE JAM FLOOD MITIGATION: SALMON RIVER, IDAHO.

White, K.D., Multi-objective approaches to floodplain management, Madison, WI, Association of State Floodplain Managers, 1992, p.250-253, 5 refs.

Proceedings of the 16th annual conference, Grand Rapids, MI, May 18-22, 1992.

47-624

ICE BOOMS, RIVER ICE, FRAZIL ICE, COST ANALYSIS, ICE JAMS, ICE CONTROL, FLOOD CONTROL

MP 3141 EFFECTS OF HYDROPOWER DEVELOPMENT ON ICE JAMMING.

Zufelt, J.E., Multi-objective approaches to floodplain management, Madison, WI, Association of State Floodplain Managers, 1992, p.254-257, 2 refs. Proceedings of the 16th annual conference, Grand Rapids, MI, May 18-22, 1992.

47-625

RIVER ICE, FRAZIL ICE, ELECTRIC POWER, ICE JAMS, DAMS, FLOOD CONTROL

MP 3142 SUB-BOTTOM PROFILING: A COMPARISON OF SHORT-PULSE RADAR AND ACOUSTIC DATA.

Delaney, A.J., Sellmann, P.V., Arcone, S.A., *Finland. Geological Survey. Special paper*, 1992, No.16, International Conference on Ground Penetrating Radar, 4th, Rovaniemi, Finland, June 8-13, 1992. Edited by P. Hanninen and S. Autio, p.149-157, 15 refs.

47-634

BOTTOM TOPOGRAPHY, SUBSURFACE INVESTIGATIONS, ACOUSTIC MEASUREMENT, LAKES, RADAR PHOTOGRAPHY, UNDERWATER ACOUSTICS, LACUSTRINE DEPOSITS, BOTTOM SEDIMENT

To compare their abilities to map sub-bottom features, short-pulse radar and an acoustic system were operated on freshwater lakes. Data were recorded on lakes with varying water depth, conductivity, and bed conditions. This report provides a qualitative discussion of the results, as samples from and velocities of the bed were not obtained. The radar antennas were resistively loaded linear dipoles operating at a center frequency of 50 MHz and excited by a 1000-W peak power transmitter. The antennas and electronics were sealed in watertight tubes and floated alongside the survey boat. The acoustic system operated at 7 kHz with peak output power of 2000 W. Both systems had a pulse length in water of about 50-170 cm, and the acoustic system had a slightly narrower beam width. Both the radar and acoustic profiles show distinct reflections from the bed, the bedrock beneath the bed, discrete targets within the bed, and sedimentary horizons. Acoustics has the potential for greater sub-bottom penetration. At the sites studied, radar appeared to show better detail on sedimentary layering, with an estimated penetration of 3-5 m beneath the bed. In lakes having water of low conductivity, sub-bottom layering was apparent for water depths exceeding 25 m. Radar performance appears reduced in low-density bed sediments. Isolated targets within the bed sediments, which were not always detected by both methods, were better defined by the acoustic system; closely spaced targets on the bed were better defined by radar. The radar also performed well in shallow water where the acoustic system would not trigger reliably. These observations indicate that radar and acoustics can provide an effective complementary means for acquiring sub-bottom data in freshwater surveys.

MP 3143 BEAUFORT SEA ICE-1: SELECTED SAR RESULTS.

Lukowski, T.I., Livingstone, C.E., August, N.M., Nordstrom, P.A., Farmer, L.D., *International Geoscience and Remote Sensing Symposium*, 12th, Houston, TX, May 26-29, 1992. IGARSS '92. International space year: space remote sensing. Vol.1, New York, Institute of Electrical and Electronics Engineers, 1992, p.131-133, 6 refs.

47-641

SEA ICE DISTRIBUTION, DRIFT, AERIAL SURVEYS, AIRBORNE RADAR, SYNTHETIC APERTURE RADAR, RADIOMETRY, DATA PROCESSING, ICE SURVEYS, ICE COVER THICKNESS, BEAUFORT SEA

Beaufort Sea Ice-1 was an international experiment carried out in the early spring of 1990 in the Alaskan Beaufort Sea. SAR imagery was acquired by the CCRS C/X-SAR at the onset of melt over an eleven day period in wide swath and nadir mode. Initial efforts in analysis of the SAR imagery have been in the radiometric calibration of nadir mode imagery, especially that of C-band. This has provided refinement of techniques, study of limitations of the methodology, and experience in the utilization of the CCRS software for calibration. In this paper, the details of the acquisition are given, procedures in calibration outlined, and results for differential scattering coefficient for the shear zone for an incidence angle range of 15 to 60 deg are presented.

MP 3144 COMPARISON OF MILLIMETER-WAVE RADAR OBSERVATIONS OF SNOW WITH

ENERGY AND MASS TRANSFER SIMULATION.

Davis, R.E., Jordan, R., Nagle, J.A., Boyne, H.S., International Geoscience and Remote Sensing Symposium, 12th, Houston, TX, May 26-29, 1992.

IGARSS '92. International space year: space remote sensing. Vol.1, New York, Institute of Electrical and Electronics Engineers, 1992, p.815-817, 5 refs.

47-658

SNOW THERMAL PROPERTIES, SNOW DENSITY, RADAR ECHOES, BACKSCATTERING, COMPUTERIZED SIMULATION, SNOW SURVEYS, SNOW WATER CONTENT, SNOW HEAT FLUX

This study compares variations in measurements of FM-CW radar backscatter with simulated snow properties from a model based on mass and energy transfer and surface energy budgets. The radar frequency range is 26.5-40 GHz. The backscatter response to wet snow is highly sensitive to fluctuations of the surface energy exchange when the snow has a low liquid water content. Analysis of the net radiation, turbulent exchange and net energy budget in the top few millimeters of snow provides a reasonable explanation of the observed backscatter variations. The near-surface liquid water content simulated by the model does not show the magnitude of changes expected when compared with the radar return. This allows a detailed evaluation of model algorithms, which account for liquid water drainage and evaporation from the surface as well as densification and consolidation of the top snow layer.

MP 3145

DIELECTRIC PROPERTIES OF ICE AND SNOW AT 26.5 TO 40 GHZ.

Koh, G., International Geoscience and Remote Sensing Symposium, 12th, Houston, TX, May 26-29, 1992. IGARSS '92. International space year: space remote sensing. Vol.1, New York, Institute of Electrical and Electronics Engineers, 1992, p.820-822, 9 refs.

47-660

DIELECTRIC PROPERTIES, ICE CRYSTAL SIZE, SNOW ICE INTERFACE, RADAR ECHOES, ATTENUATION, SNOW SURVEYS, SNOW ELECTRICAL PROPERTIES, ICE ELECTRICAL PROPERTIES, SNOW DENSITY

A network analyzer based system operating at 26.5 to 40 GHz was used to measure the propagation velocity and attenuation of synthetically generated pulses in ice and snow in order to obtain their dielectric properties. The real part of ice dielectric constant was 3.155 and independent of frequency. The imaginary part increased from 0.002 at the lower frequencies to 0.004 at the higher frequencies. The effective dielectric constant of snow as a function of snow volume fraction was measured. The real part was proportional to the snow volume fraction; however the loss factor in snow showed a more complicated relationship.

MP 3146

LONG-TERM STUDY OF MICROWAVE PROPAGATION OVER CHANGING GROUND AND SNOW COVER.

Peck, L., International Geoscience and Remote Sensing Symposium, 12th, Houston, TX, May 26-29, 1992. IGARSS '92. International space year: space remote sensing. Vol.2, New York, Institute of Electrical and Electronics Engineers, 1992, p.1144-1146, 6 refs.

47-671

SNOW COVER EFFECT, SNOW DEPTH, SNOW WATER CONTENT, SOIL WATER, MICROWAVES, RADAR ECHOES, WAVE PROPAGATION, SNOW SURVEYS, SNOW ELECTRICAL PROPERTIES

A year-round experiment with a bistatic microwave (10.5-GHz) radar has documented environmental effects on microwave propagation on both daily and seasonal time scales. The continuously monitored automatic gain control (AGC) of the receiver provides a long-term record of relative changes in the microwave field due to such factors as characteristics of the snow cover, soil moisture, frozen/thawed state of the soil, and vegetation type and height.

MP 3147

TOWARDS A QUANTITATIVE CHARACTERIZATION OF SEA ICE MICROSTRUCTURE.

Perovich, D.K., Gow, A.J., International Geoscience and Remote Sensing Symposium, 12th, Houston, TX, May 26-29, 1992. IGARSS '92. International space year: space remote sensing. Vol.2, New York, Institute of Electrical and Electronics Engineers, 1992, p.1249-1252, 11 refs.

47-672

SEA ICE, ICE SURFACE, RADIOMETRY, REMOTE SENSING, MICROWAVES, STATISTICAL ANALYSIS, ICE SURVEYS, ICE ELECTRICAL PROPERTIES, ICE MICROSTRUCTURE

Sea ice has an intricate and highly variable microstructure consisting of ice platelets, brine inclusions, and air bubbles. Current microwave models require a quantitative description of this

microstructure. One such descriptor is the inclusion size distribution. A variety of thin sections were processed in order to investigate the effects of spatial variability, changes in ice temperature, and different ice types on the inclusion size distribution. The distributions were determined by using a personal-computer-based image processing system to analyze horizontal thin sections of the ice. Results indicate that, in general, size distributions are governed by a negative power law relating the number of inclusions to the inclusion area. Mean diameters were tenths of a millimeter for brine inclusions and millimeters for air bubbles.

MP 3148

EFFECTIVE PERMITTIVITY OF SALINE ICE UNDER THERMAL VARIATION.

Nghiem, S.V., Kwok, R., Kong, J.A., Shin, R.T., Gow, A.J., Arcone, S.A., International Geoscience and Remote Sensing Symposium, 12th, Houston, TX, May 26-29, 1992. IGARSS '92. International space year: space remote sensing. Vol.2, New York, Institute of Electrical and Electronics Engineers, 1992, p.1256-1258, 7 refs.

47-674

SEA ICE, ICE SALINITY, ICE TEMPERATURE, RADIOMETRY, REMOTE SENSING, ICE SURVEYS, ICE ELECTRICAL PROPERTIES, SALT ICE

A model to calculate the effective permittivity of saline ice under thermal variation is presented in this paper. The model includes multi-phase inhomogeneities with multiple species characterized by orientation, size, and shape distributions. The model is then used to derive the effective permittivity as a function of temperature under the strong fluctuation theory which is extended to account for the complexity. The results calculated from the model are compared with experimental data at 4.8 GHz for saline ice grown at the US Army Cold Regions Research and Engineering Laboratory (CRREL). The comparison between measured and calculated complex permittivities is good for the imaginary part, and the difference is within 10% for the real part.

MP 3149

COMPARISON OF NORMALIZED RADAR CROSS SECTION MEASUREMENTS AND MODELS FOR SNOW COVER AT 35, 95, AND 225 GHZ.

Lohmeier, S.P., Langlois, P.M., Colom, J.G., Davis, R.E., Boyne, H.S., McIntosh, R.E., International Geoscience and Remote Sensing Symposium, 12th, Houston, TX, May 26-29, 1992. IGARSS '92.

International space year: space remote sensing. Vol.2, New York, Institute of Electrical and Electronics Engineers, 1992, p.1655-1657, 2 refs.

47-686

SNOW COVER EFFECT, SNOW DEPTH, SNOW WATER CONTENT, SNOW DENSITY, SNOW TEMPERATURE, RADAR ECHOES, BACKSCATTERING, SNOW SURVEYS, SNOW ELECTRICAL PROPERTIES

During the winter of 1990-1991, 35, 95 and 225 GHz radar cross section measurements were made at the University of Massachusetts in Amherst, MA and at the U.S. Army Cold Regions Research and Engineering Laboratory in Hanover, NH. Parameters characterizing the snow and weather condition were measured concurrently with the radar measurements. A theoretical model proposed by Narayanan and McIntosh was able to predict the value for radar cross section with good accuracy and minimal computation. However, this model fails to predict the measured bias of VV over HH polarization that consistently occurs with increasing incidence angle. Variations in snow liquid water content have the greatest effect on the measured and predicted values of radar cross section at all three frequencies. The presence of water has the effect of decreasing NRCS. This effect is deemphasized as water content increases. One problem in making comparisons is the accuracy of the liquid water content measurements. Current methods of measuring liquid water content are only accurate to 1%, while smaller changes in liquid water content have an appreciable effect on the radar cross section of the snow.

MP 3150

POLARIMETRIC AND MULTIFREQUENCY SAR SIGNATURES OF WET SNOW.

Rott, H., Davis, R.E., Dozier, J., International Geoscience and Remote Sensing Symposium, 12th, Houston, TX, May 26-29, 1992. IGARSS '92.

International space year: space remote sensing. Vol.2, New York, Institute of Electrical and Electronics Engineers, 1992, p.1658-1660, 5 refs.

47-687

SNOW ELECTRICAL PROPERTIES, SNOW SURFACE, SYNTHETIC APERTURE RADAR, RADAR ECHOES, AERIAL SURVEYS, SNOW SURVEYS, SNOW WATER CONTENT, WET SNOW

C-, L- and P-band polarimetric signatures of wet snow surfaces have been analyzed, based on AIRSAR surveys of the Alpine test site in Ötztal in the summers of 1989 and 1991. The importance of surface roughness is evident in the C- and L-band signatures, whereas the diffuse scattering contribution by internal inhomoge-

neities in the snowpack increases from the C- to the P-band at incidence angles below 50 deg due to increasing penetration.

MP 3151

PRELIMINARY STUDY OF THE EFFECT OF FINES ON SANDED-ICE FRICTION.

Blaisdell, G.L., Borland, S.L., *Cold regions science and technology*, Sep. 1992, 21(1), p.79-90, 11 refs.

47-805

SLIDING, TEMPERATURE EFFECTS, MECHANICAL TESTS, RUNWAYS, RUBBER ICE FRICTION, SKID RESISTANCE, FINES, SANDS, DESIGN CRITERIA

Small-scale laboratory tests were performed on sanded ice. Four standard sands, as specified by various regulatory agencies, were tested. Sliding friction was measured for a rubber-faced slider for each sand type at a temperature of -10 C on three prepared surfaces: bare ice, loose sanded ice and ice with sand frozen on. Friction coefficients for bare ice were found to be higher than those measured on loosely sanded ice and, in some cases, on ice with sand frozen on. Test results, presented as a performance ratio (ratio of coefficients for sanded ice to bare ice), allowed a distinct ranking of the sands' effectiveness. Performance ratios for frozen-on sand were significantly greater than for loose sand for a given sand type. The performance ratio showed a strong, linearly increasing trend as the percentage of a given fine grain size in the sand was increased. It was found that this line had a steeper slope for the percentage of material smaller than 0.177 mm as compared with that smaller than 0.297 mm. Also, there were greater increases in traction with increases in fines for frozen-on sand as compared with loosely sanded ice.

MP 3152

COMPARISON OF ANALYTICAL METHODS FOR DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN SOILS.

Hewitt, A.D., Miyares, P.H., Leggett, D.C., Jenkins, T.F., *Environmental science & technology*, 1992, 26(10), p.1932-1938, 28 refs.

47-862

CHEMICAL ANALYSIS, DETECTION, WASTE DISPOSAL, ENVIRONMENTAL IMPACT, SOIL POLLUTION, SOIL CHEMISTRY

This study compares aqueous extraction headspace/gas chromatography and purge-and-trap gas chromatography/mass spectrometry (EPA SW-846, method 8240) for the determination of four volatile organic compounds (VOCs) in soil. Comparisons were performed on two fortified soils and two soils obtained from sites where hazardous waste had been spilled or disposed. In only two of the cases studied were significant differences consistently found: for the two most hydrophobic compounds in a high organic carbon soil, and for TCE in a field-contaminated soil that had previously shown slow aqueous VOC desorption. The findings strongly suggest that aqueous extraction/headspace GC using a portable instrument can be used to screen soils on site for VOCs, providing rapid same-day results, that will consistently identify the presence of these analytes and provide quantitative results which are generally not significantly different from slower and more expensive laboratory-based purge-and-trap analysis.

MP 3153

MINIMUM SAMPLING FOR SPECTRAL ANALYSIS OF NONSTATIONARY TURBULENCE.

Treviño, G., Andreas, E.L., Symposium on Turbulence and Diffusion, 10th, Portland, OR, Sep. 29-Oct. 2, 1992, Boston, American Meteorological Society, 1992, p.289-292, 10 refs.

47-867

TIME FACTOR, STATISTICAL ANALYSIS, MATHEMATICAL MODELS, ATMOSPHERIC DISTURBANCES, TURBULENCE

MP 3154

AIR-ICE DRAG COEFFICIENT IN THE WEDDELL SEA DEDUCED FROM PROFILE MEASUREMENTS.

Andreas, E.L., Claffey, K.J., Symposium on Turbulence and Diffusion, 10th, Portland, OR, Sep. 29-Oct. 2, 1992, Boston, American Meteorological Society, 1992, p.J5/109-J5/112, 12 refs.

47-868

ICE SURFACE, ICE COVER EFFECT, SURFACE ROUGHNESS, TURBULENT BOUNDARY LAYER, STATISTICAL ANALYSIS, ICE AIR INTERFACE, DRIFT, WIND PRESSURE, WIND VELOCITY, ANTARCTICA--WEDDELL SEA The air-ice drag coefficient provides a convenient way to estimate the surface stress on sea ice from a measurement of the average wind speed at some reference height, in this case at 10 meters, multiplied by the root-mean-square sea ice surface roughness in centimeters. Air-ice drag coefficients were determined from wind speed profiles collected on Ice Station Weddell 1 which drifted through the western Weddell Sea on a multiyear ice floe from February to June 1992. The drag coefficients at 10 m ranged from .0013 to .0025 with an average of .0019. However, calculating the surface stress on an ice floe from the surface roughness and average drag coefficient value is an oversimplification because a 10 degree shift in wind direction may change the sur-

face stress by a factor of two.

MP 3155

POTENTIAL OF COMMON WELL CASING MATERIALS TO INFLUENCE AQUEOUS METAL CONCENTRATIONS.

Hewitt, A.D., *Ground water monitoring review*, Spring 1992, p.131-136, 14 refs. 47-879

WATER CHEMISTRY, CHEMICAL ANALYSIS, ENVIRONMENTAL PROTECTION, METALS, STATISTICAL ANALYSIS, SOIL POLLUTION, WELL CASINGS, WATER POLLUTION, GROUND WATER

Static leaching and sorption laboratory studies were performed to assess the potential of polyvinyl chloride (PVC), polytetrafluoroethylene (PTFE), and two types of stainless steel (SS 304 and SS 316) well casing materials to influence metal concentrations in ground water solutions with low dissolved oxygen. Overall, PTFE was inert, whereas one or both stainless steels significantly altered the solution concentrations of Cd, Cr, Cu, Pb, Fe, and Ni. PVC was generally more reactive than PTFE, but did not significantly alter the solution metal concentrations as often, or as greatly, as either of the stainless casings.

MP 3156

PREDICTED HEIGHTS OF BUOYANT CONVECTION ABOVE OPEN LEADS IN THE WINTER ARCTIC PACK ICE COVER.

Serreze, M.C., Maslanik, J.A., Stone, R.S., Schnell, R.C., Kahl, J.D., Andreas, E.L., Conference on Polar Meteorology and Oceanography, 3rd, Portland, OR, Sep. 29-Oct. 2, 1992, Boston, American Meteorological Society, 1992, p.J3/45-J3/48, 18 refs. 47-880

ATMOSPHERIC CIRCULATION, PACK ICE, ICE COVER EFFECT, CONVECTION, MATHEMATICAL MODELS, AIR ICE WATER INTERACTION, ICE OPENINGS, POLAR ATMOSPHERES

MP 3157

REGIONAL CONUS SNOWFALL INTENSITY AND INFERRED GLOBAL PATTERNS.

Ryerson, C.C., Bates, R.E., EOSAEL/TWI Conference, 10th, Las Cruces, NM, Nov. 28-30, 1989. Proceedings, U.S. Army Atmospheric Sciences Laboratory, 1990, p.111-122, 10 refs. 47-911

SNOWFALL, MILITARY OPERATION, VISIBILITY, SNOW WATER EQUIVALENT, SNOWSTORMS

Performance of battlefield millimeter-wave infrared and visible target acquisition systems during snowfall is a function, in part, of snowfall intensity. Snowfall intensity varies widely spatially and temporally within individual storms, as well as within regions. Regional snowfall intensity was computed and mapped from the National Weather Service (NWS) 6-hour synoptic reports to show general CONUS patterns. The percentage of annual snowfall events that are high in intensity is greatest in mountainous areas and along the East Coast. Intensities in most cases show no strong relationship to seasonal snow cover depth or persistence. Synoptic interpretation of two storms demonstrates one approach to mapping high intensity snowfall areas on a global scale from CONUS analogues. Supporting maps and statistics are presented in the paper.

MP 3158

PHYSICAL PROPERTIES OF SUSPENDED ICE CRYSTALS WITH RESPECT TO OPTICAL EFFECTS.

Hogan, A.W., EOSAEL/TWI Conference, 10th, Las Cruces, NM, Nov. 28-30, 1989. Proceedings, U.S. Army Atmospheric Sciences Laboratory, 1990, p.123-132, 15 refs. 47-912

ICE CRYSTAL OPTICS, ICE CRYSTAL SIZE, VISIBILITY, PHYSICAL PROPERTIES

MP 3159

BRAKING TRACTION ON SANDED ICE AT LOW SLIP RATES.

Blaisdell, G.L., Borland, S.L., International Symposium on Snow Removal and Ice Control Technology, 3rd, Minneapolis, MN, Sep. 14-18, 1992. Preprints. Vol.1, Washington, D.C., National Research Council, Transportation Research Board, 1992, 28p., 7 refs. 47-939

ROAD MAINTENANCE, SANDS, ENVIRONMENTAL TESTS, ROAD ICING, SANDING, TRACTION, RUBBER ICE FRICTION

Ice traction enhancement on pavements using abrasives was evaluated in this study. The abrasives tested were five distinct gradations of sand built from a single host material. Four of the sands represented standard gradations as specified by the Federal Aviation Administration, the Society of Automotive Engineers, the American Society for Testing and Materials, and Transport Can-

ada. Braking traction at a constant slip rate was measured with a full-size, self-contained instrumented vehicle. All tests were performed on an ice sheet located inside a large refrigerated room. Results showed that coarse sands perform best on cold ice surfaces and finer sands excel on warm ice. Good performance independent of ice temperature can be expected for sands with the bulk of their grains in the 1-2 mm diameter range. The authors also found that the concentration of a sand on ice very strongly influences the degree of traction enhancement as does the temperature of the sand grains when they are applied to the ice.

MP 3160

THREE-DIMENSIONAL VISCOPLASTIC FLOW MODEL OF POLYCRYSTALLINE ICE.

Fish, A.M., International Conference on Ice Technology, 3rd, Cambridge, MA, Aug. 11-13, 1992. Proceedings. Edited by T.K.S. Murthy, W.M. Sackinger and P. Wadhams, Southampton, England, Computational Mechanics Publications, 1992, p.193-207, 22 refs. 47-1029

ICE CRYSTALS, ICE CREEP, ICE MODELS, ICE STRENGTH, ICE MECHANICS, RHEOLOGY, MATHEMATICAL MODELS

A three-dimensional constitutive equation has been developed for viscoplastic flow (secondary creep) of polycrystalline ice. The stress dependency of the minimum creep shear strain rate is described by a flow equation that includes a yield criterion of ice. The latter is selected either in the form of an extended (parabolic) von Mises-Drucker-Prager or an extended (parabolic) Mohr-Coulomb rupture model in which the ice strength is characterized by three parameters: the cohesion, the friction angle on the octahedral plane, and the ice melting pressure, i.e. the magnitude of the hydrostatic stress at which the ice strength reaches a maximum.

MP 3161

SOURCE STRENGTH TERMS FOR WINTER DISPERSION MODELS.

Hogan, A.W., Leggett, D.C., Battlefield Atmospherics Conference, El Paso, TX, Dec. 3-6, 1991. Proceedings, White Sands, NM, Atmospheric Sciences Laboratory, U.S. Army Laboratory Command, 1992, p.149-155, 4 refs. 47-1069

MILITARY OPERATION, DISPERSIONS, SNOW COVER EFFECT, SNOW AIR INTERFACE, SNOW SURFACE TEMPERATURE, AIR TEMPERATURE, MODELS

It is now frequently necessary to prepare an estimate of atmospheric dispersion of aerosols, vapors, and gases before beginning Engineer operations. Several dispersion models prepared by the DOD/DOE/NOAA community have been examined for application in data-sparse winter settings. The combustion rate terms, or thermodynamic properties of gases, used to estimate the contaminant input to the atmosphere from uncontrolled sources acquire an additional degree of complexity over snow-covered ground. Multiple inversions may limit the applicability of even nearby soundings of atmospheric structure to wind field analysis. Some analyses of organic vapor permeation in snow cover, coincident with nearby atmospheric structure observations, are presented as a preliminary approach to over-snow dispersion modelling.

MP 3162

ATTENUATION OF OUTDOOR SOUND PROPAGATION LEVELS BY A SNOW COVER.

Albert, D.G., San Diego, University of California, 1991, 278p., University Microfilms order No.AAC9130719, Ph.D. thesis. For abstract see Dissertation abstracts international, Sec. B, Nov. 1991, p.2606. 46-5264

ACOUSTIC MEASUREMENT, SEASONAL VARIATIONS, SNOW ACOUSTICS, SNOW COVER EFFECT, SOUND TRANSMISSION, WAVE PROPAGATION, ATTENUATION, POROSITY, SNOW AIR INTERFACE

MP 3163

IMPLEMENTATION OF A MMW FM-CW RADAR SYSTEM FOR STUDY OF SURFACE SCATTERING FROM FRESHWATER LAKE AND RIVER ICE SHEETS.

Yankielun, N.E., Crane, R.K., U.S. Army Research Office. Report, Dec. 1991, ARO-28962.2-GS-EQ, 20p., ADA-250 589, 1 ref. 47-888

ICE SURFACE, LAKE ICE, RIVER ICE, ICE ELECTRICAL PROPERTIES, RADIO ECHO SOUNDINGS, RADAR, SCATTERING, COMPUTER APPLICATIONS, ICE SURVEYS, ICE COVER THICKNESS

MP 3164

EFFECT OF A GEOTEXTILE ON WATER MIGRATION AND FROST HEAVE IN A LARGE-SCALE TEST BASIN.

Shoop, S.A., Henry, K.S., *Transportation research record*, 1991, No.1307, p.309-318, 15 refs. 47-1129

WATER TABLE, COUNTERMEASURES, CAPILLARITY, SOIL FREEZING, SOIL TESTS, GEOTEXTILES, SOIL WATER MIGRATION, FROST HEAVE, FROZEN GROUND MECHANICS

The objective of this study was to examine the effect of a needle-punched polyester geotextile on moisture migration and frost heave during freezing and thawing in a large test basin. Non-woven polypropylene geotextiles have proved effective in reducing frost heave in laboratory tests. In this case, a needle-punched polyester geotextile separator was monitored for its influence on frost heave and soil moisture tension for four freeze-thaw cycles in a large test basin. Results from freezing tests in the test basin without a water table and with a water table present 12.7 cm below the fabric suggest that use of the fabric results in greater frost heave. When the water table was above the fabric, the fabric had no influence on frost heave or water distribution in the soil. Laboratory tests indicate that the separator had no effect on frost heave. Tensiometer data in the test basin indicate that lateral transmission of water through the fabric may have occurred, so transmission of water from thawed soil to freezing soil may have contributed to increased frost heave. It is concluded that if a geotextile is used in frost-susceptible soil, proper drainage and the correct fabric type must be used to prevent increased frost heave.

MP 3165

UNCERTAINTY IN A PATH-AVERAGED MEASUREMENT OF THE FRICTION VELOCITY U^* .

Andreas, E.L., *Journal of applied meteorology*, Nov. 1992, 31(11), p.1312-1321, 39 refs. 47-1121

SCINTILLATION, ANALYSIS (MATHEMATICS), MEASUREMENT, TURBULENT BOUNDARY LAYER, TURBULENT FLOW, TURBULENT DIFFUSION, ATMOSPHERIC PHYSICS, SURFACE ENERGY, HEAT FLUX

Several electro-optical methods exist for measuring a path-averaged value of the inner scale of turbulence. By virtue of Monin-Obukhov similarity, in the atmospheric surface layer such measurements are related to the friction velocity or to the surface stress. Because the inner scale of turbulence is a path-averaged quantity, so, too is the friction velocity. Here the question of how precisely friction velocity can be measured is investigated by combining these inner-scale measurements with two-wavelength scintillation measurements that yield the sensible and latent heat fluxes, and thereby facilitate stability corrections. The analysis suggests that current path-averaging instruments can generally measure friction velocity to $\pm 20-30\%$.

MP 3166

PERFORMANCE OF ASPHALT CONCRETE AIRPORT PAVEMENTS DURING THAW WEAKENING PERIODS: A FIELD STUDY.

Janoo, V.C., Berg, R.L., Tomita, H., *Canadian Technical Asphalt Association. Proceedings*, Nov. 1992, Vol.37, p.167-183, 14 refs. 47-1135

ANALYSIS (MATHEMATICS), THAW WEAKENING, LOADS (FORCES), FREEZE THAW CYCLES, PAVEMENTS, SUBGRADES, BITUMINOUS CONCRETES, AIRPORTS, THAW DEPTH, FROST PENETRATION

Many airport pavement structures are subjected to freezing in the winter and thawing in the spring. In winter, the load-carrying capacity of the pavement increases dramatically due to freezing of the pavement structure. In spring, the pavement structure thaws and can become saturated with water from the melting ice lenses, thus reducing the strength of the base, subbase and/or subgrade. The U.S. Army Cold Regions Research and Engineering Laboratory (USACRREL) conducted Falling Weight Deflectometer (FWD) measurements for the Federal Aviation Administration (FAA) at several airports in Wisconsin. One was Wittman Field in Oshkosh, where the pavement surface was mainly asphalt concrete. In addition to FWD measurements, surface and subsurface pavement temperatures were measured at selective sites. The objective of the study was to determine the change in the load-bearing capacity of airport pavement structures in a seasonal frost area during thaw-weakening periods, using the FWD and methods developed at CRREL from test results obtained in the Frost Effects Research Facility (FERF). This paper gives a general description of the airport pavement structures and summarizes the results of the analysis of the FWD measurements from Wittman Airfield, Oshkosh.

MP 3167

LOW TEMPERATURE CRACKING EXPERIMENT AT USACRREL FROST EFFECTS RESEARCH FACILITY.

Kanerva, H.K., Vinson, T.S., Brickman, A.M., Janoo, V.C., *Canadian Technical Asphalt Association. Pro-*

ceedings, Nov. 1992, Vol. 37, p. 289-307.

47-1139

LOW TEMPERATURE RESEARCH, LOW TEMPERATURE TESTS, CRACKING (FRACTURING), PAVEMENTS, BITUMINOUS CONCRETES, CEMENTS, THERMOCOUPLES

Under Strategic Highway Research Program Contract A-003A, several field test roads related the Thermal Stress Restrained Specimen Test (TSRST) laboratory fracture temperature to the cracking temperature and crack frequency in the field. However, observing the moment of cracking and temperature for the field test sections is very difficult. In addition, variations in microclimate, restraint conditions, pavement structure and subgrade complicate an interpretation of observations in the field. For these reasons, a low temperature cracking experiment was conducted at USACRREL Frost Effects Research Facility (FERF) in summer 1991. The test program consisted of two phases. In Phase I the influence of the pavement geometry and slab thickness on low temperature cracking was investigated. Phase II focused on the low-temperature performance of different asphalt cements. In this phase, four sections were constructed. Each section contained a different asphalt cement. Temperatures at the bottom and top of the insulation, in the middle of the base course and at the bottom and surface of the pavement were recorded monotonically, using cooling panels placed directly on the surface of the pavement. Cracking temperatures for a total of 17 cracks were recorded.

MP 3168

ICEBERG/SEABED INTERACTION EVENTS OBSERVED DURING THE DIGS EXPERIMENT.

Lever, J.H., Bass, D.W., Lewis, C.F.M., Klein, K., Diemand, D., Dyke, M., *Journal of offshore mechanics and arctic engineering*, Feb. 1991, Vol. 113, p. 74-87, 33 refs. For another version see 43-2629.

47-1140

DRIFT, GROUNDED ICE, BOTTOM TOPOGRAPHY, OCEAN BOTTOM, SUBSURFACE INVESTIGATIONS, ICEBERGS, ICE SCORING, LABRADOR SEA

The Dynamics of Iceberg Grounding and Scouring (DIGS) experiment was conducted in the Labrador Sea during Aug. 1985. The objectives of the experiment were to obtain full-scale data sets documenting iceberg/seabed interactions, and to obtain by direct observation new information regarding the processes of iceberg scour formation and degradation. Utilizing a vessel and a helicopter, measurements were made of icebergs' above and below-water shapes, plus local winds, waves, currents and tides. Special self-contained motion monitoring packages were deployed by helicopter on icebergs thought to be good grounding candidates. Seabed observations were made directly using the submersible Pisces IV, and extensive side-scan sonar data were collected. This paper describes two dynamic iceberg/seabed interaction events documented during DIGS: the roll/pitting behavior of the 1.2 million-ton domed iceberg "Bertha," and the split/grounding behavior of the 7.7 million-ton tabular iceberg "Gladys." This latter event is particularly interesting due to its very energetic nature, and the fact that it represents the only full-scale observation of any iceberg impact with sufficient documentation to yield estimates of the interaction forces. Subsequent to the experiment, the recorded above and below-water shapes were used to obtain hydrostatic stability maps for these icebergs. A time stepping procedure was also developed to re-create these two dynamic events, and comparisons between the observed and simulated motions are provided.

MP 3169

HYDROELASTIC STABILITY OF MARINE RISERS.

Rzentkowski, G., Hinchey, M.J., Lever, J.H., Marine Dynamics Conference, St. John's, Newfoundland, 1991, [1991], p. 31-41, 37 refs.

47-1141

HYDRODYNAMICS, DYNAMIC LOADS, OCEAN CURRENTS, OCEAN WAVES, WATER PRESSURE, STABILITY, MATHEMATICAL MODELS, OFFSHORE STRUCTURES, PIPELINES, DAMPING

This paper presents an overview of hydroelastic stability concepts for multi-pipe marine risers. Marine risers extending over large depths are exposed to a variety of hydrodynamic loads arising from wave and current actions. These loads may induce two types of oscillations: (i) an overall riser motion due to waves, and (ii) relative pipe motions due to waves and current. Relative pipe motions can be generated by asymmetric vortex shedding, in a process known as Strouhal periodicity, and by the turbulence in the stream set-up by flow separation and wake formation behind upstream pipes. They may also be generated by hydroelastic phenomena. Here, the elastic array can extract energy from the flow leading to violent self-excited oscillations. Since these mechanisms can exist simultaneously, the state of riser motion is rather complex, and it may be stable in one respect and unstable in another. In the present paper, the authors investigate the question of hydroelastic stability from various points of view, depending on the source of excitation and its physical properties, by considering a particularly simple non-linear oscillator. Implications for riser design are also outlined and discussed.

MP 3170

EFFECTS OF TEMPERATURE ON AN ISL-PVDF SHOCK SENSOR BETWEEN +20 C AND -40 C.

Solie, D.J., Johnson, J.B., Dutta, P.K., Kalafut, J., American Physical Society Topical Conference, 7th, Williamsburg, VA, June 17-20, 1991. Shock compression of condensed matter—1991. Edited by S.C. Schmidt, R.D. Dick, J.W. Forbes, and D.G. Tasker, Amsterdam, Elsevier Science Publishers, 1992, p. 891-892, 4 refs.

47-1142

SNOW COMPRESSION, TEMPERATURE EFFECTS, SHOCK WAVES, STRAIN MEASURING INSTRUMENTS
Temperature calibration tests were done on a Metravib ISL-PVDF shock sensor using a Hopkinson bar from +20 C to -40 C at three pressure levels: 22 MPa, 38 MPa and 48 MPa. Nearly a 50% decrease in peak signal amplitude at all three pressure levels was observed for a shock sensor temperature decrease from +20 C to -40 C. The data were well described using a linear fit. The average sensor output decreased (relative to 20 C) -0.72% +/- 0.10%/deg C down to -40 C.

MP 3171

SHOCK WAVE STUDIES OF SNOW.

Johnson, J.B., Brown, J.A., Gaffney, E.S., Blaisdell, G.L., Sturm, M.A., Barrett, S.A., American Physical Society Topical Conference, 7th, Williamsburg, VA, June 17-20, 1991. Shock compression of condensed matter—1991. Edited by S.C. Schmidt, R.D. Dick, J.W. Forbes, and D.G. Tasker, Amsterdam, Elsevier Science Publishers, 1992, p. 107-110, 10 refs.

47-1143

WAVE PROPAGATION, SNOW DENSITY, SNOW TEMPERATURE, SHOCK WAVES, SNOW COMPRESSION, SNOW DEFORMATION

Shock-wave studies of snow have been conducted at stress levels of up to 40 MPa. Analysis of embedded gauges and shock-reverberation techniques were used to determine shock pressure-density data for snow with initial densities ranging from 100 kg/cu m to 520 kg/cu m and temperature ranging from -2 C to -23 C. Shock velocities ranged from about 170 m/s for low density snow to about 280 m/s for high density snow. At constant density and impact velocity, but varying temperature, there was little variation in shock velocity. This indicates that the internal energy and any temperature dependent strength of ice bonds do not measurably affect shock propagation in snow over the temperature and pressure range of these tests. The results also indicate that snow is a highly rate-sensitive material.

MP 3172

SIMULATING MULTIDIMENSIONAL SNOW TEMPERATURE RESPONSE TO A BURIED OBJECT UNDER CHANGING METEOROLOGICAL CONDITIONS.

Albert, M.R., McGilvary, W.R., Winter annual meeting, Anaheim, CA, Nov. 8-13, 1992, New York, American Society of Mechanical Engineers, 1992, 7p., 4 refs.

47-1144

DETECTION, SUBSURFACE INVESTIGATIONS, SNOW THERMAL PROPERTIES, SNOW COVER EFFECT, MATHEMATICAL MODELS, SNOW SURFACE TEMPERATURE, INFRARED PHOTOGRAPHY

A multidimensional finite element model is used to conduct preliminary numerical investigations of the effect of a buried cylinder on snow surface temperatures. The effects of two cylinder materials (aluminum and phenolic) and two snow types are investigated under varied meteorological influences. For the cases investigated, the variability of snow surface temperatures resulted from the ability of the buried object to conduct heat at different rates than the snow and from the ability of the object to retain heat differently than snow. These effects are sufficient to cause a significant thermal contrast at the snow surface. The thermal characteristics of the snow play a large part in the heat balance, and thus the metamorphosis of the snowpack characteristics may control thermal imagery results from objects buried under the snow. The snow surface temperature variability from this investigation is in excess of one centigrade degree, a sufficient amount to be of importance in infrared imagery.

MP 3173

PHYSICAL VARIATION OF WATER VAPOR, AND THE RELATION WITH CARBON DIOXIDE.

Egan, W.G., Hogan, A.W., Zhu, H., *Geophysical research letters*, Dec. 1991, 18(12), p. 2245-2248, 30 refs.

47-1145

ATMOSPHERIC CIRCULATION, MARINE ATMOSPHERES, AIR ICE WATER INTERACTION, AIR MASSES, HUMIDITY, SEASONAL VARIATIONS, POLAR ATMOSPHERES, ATMOSPHERIC COMPOSITION, WATER VAPOR, CARBON DIOXIDE

Analysis of the long-term NOAA carbon dioxide flask sample records to examine the exchange among the continental antarctic air mass and other air masses shows a meteorological variation of carbon dioxide concentration. There is an inverse relation between the seasonal variation of carbon dioxide concentration and water vapor at all stations examined. Well established diffusion coefficients indicate an interaction of water and carbon dioxide vapor on the molecular scale. Laboratory experiments using a Fourier transform spectrometer show carbon dioxide to be removed from an airstream in proportion to water vapor precipitated. The authors propose that interaction of carbon dioxide and water vapor in the atmosphere provides temporary sinks that can influence the balance of the carbon dioxide budget.

MP 3174

DEVELOPMENT OF A COMPONENT-BASED SCALING SYSTEM FOR SHIP-ICE MODEL TESTS.

Colbourne, D.B., Lever, J.H., *Journal of ship research*, Mar. 1992, 36(1), p. 77-87, 20 refs.

47-1146

ICE PRESSURE, ICE NAVIGATION, ENVIRONMENTAL TESTS, MATHEMATICAL MODELS, ICEBREAKERS, ICE BREAKING, METAL ICE FRICTION, ICE SOLID INTER-FACE

This paper presents the development and verification of a method for conducting and scaling ice resistance model tests based on division of the total resistance into three components. It is shown that each of these components is subjected to a separate scaling law. A comprehensive literature review traces development of the concept of independent components in icebreaking resistance and covers development of nondimensional scaling parameters. A system of analysis and presentation is developed based on nondimensional parameters unique to each of the identified components. A set of experiments was carried out on a highly simplified hull form model to verify the proposed experimental procedure. Data from these experiments demonstrate the excellent data collapse which can be achieved using the developed nondimensional presentation.

MP 3175

CONVERGENCE CRITERION IN MEASURING BUILDING R-VALUES.

Flanders, S.N., ASHRAE/DOE/BTECC Conference [on the] Thermal Performance of the Exterior Envelopes of Buildings, 5th, Clearwater Beach, FL, Dec. 7-10, 1992. Proceedings, Atlanta, GA, American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1992, p. 204-209, 11 refs.

47-1156

CONSTRUCTION MATERIALS, COLD WEATHER TESTS, COLD WEATHER PERFORMANCE, THERMAL STRESSES, HEAT FLUX, WEATHERPROOFING, BUILDING CODES, MATHEMATICAL MODELS, WALLS, THERMAL INSULATION, FROST RESISTANCE

ASTM C 1155, Standard Practice for Determining Thermal Resistance of Building Envelope Components from In-Situ Data, requires that a calculation of R-value converge on a steady value within criterion bounds. Some field experience suggests that this criterion is often easily met. Some theoretical studies suggest that the criterion may be blind to certain temperature-change conditions. In this paper, long-term field data are converted into synthetic pure wave forms and employed in a computational model. The convergence criterion is tested for several delay periods to determine the worst case for that set of frequencies. The investigation highlighted the effect on R-value calculations of low-frequency temperature inputs, representing periodicities of up to 500 hours. The mathematical simulations allow discrimination between conditions that cause lack of convergence and those that represent a long-term change in R-value. While the convergence strategy suggested in C 1155 is adequate, a more sophisticated algorithm would increase the reliability of the test. The automated data collection process would include periodic Fourier transforms of the hourly data that have been collected, perform a power spectrum analysis, and select the most stringent delay period for performing the convergence test.

MP 3176

PERFORMANCE PREDICTIONS FOR A PASSIVE INFRARED INTRUSION DETECTION SYSTEM.

Lacombe, J., 33rd annual meeting, Orlando, FL, July 19-22, 1992. Proceedings, Northbrook, IL, Institute of Nuclear Materials Management, 1992, p. 133-140, 6 refs.

47-1167

SENSORS, INFRARED EQUIPMENT, RADIOMETRY, STATISTICAL ANALYSIS, MATHEMATICAL MODELS, INFRARED RECONNAISSANCE, WARNING SYSTEMS, DETECTION

A study was conducted to assess the capabilities of an exterior passive infrared (PIR) intrusion detection sensor. The study involved a series of field tests and the development of a sensor performance model. This paper describes the model and presents examples of model output. System sensitivity to changes in target and background surface temperatures, target size, target range,

and target speed are shown. The PIR model should prove useful as an aid in determining the proper configuration of such sensors within a fixed-facility or tactical surveillance application.

MP 3177

EFFECTS OF SEASONAL VARIATION IN THE THERMAL BACKGROUND SCENE ON THE DETECTION CAPABILITY OF PASSIVE INFRARED INTRUSION DETECTION SYSTEMS.

Peck, L., 33rd annual meeting, Orlando, FL, July 19-22, 1992. Proceedings, Northbrook, IL, Institute of Nuclear Materials Management, 1992, p.141-144, 3 refs.

47-1168

SENSORS, INFRARED EQUIPMENT, SNOW COVER EFFECT, SEASONAL VARIATIONS, INFRARED RECONNAISSANCE, WARNING SYSTEMS, DETECTION

The interaction of a passive infrared intrusion detection system (IDS) with its environment has been studied by continuously monitoring a voltage indicative of the sensor's proximity-to-alarm status to determine its behavior as the thermal background scene changes diurnally and seasonally. Alarm voltages caused by the detection of a low-threat human intruder have also been recorded occasionally. Concurrently, site characterization data such as solar illumination, air and soil surface temperature and wind speed have been recorded for correlation with the recorded system voltages. This approach identifies situations when the background scene dynamics render the detection capability of this type of IDS unreliable, either by masking the presence of an intruder or by causing frequent non-intruder alarms. In conjunction with a performance model for a specific passive infrared IDS, such as described by J. Lacombe, an understanding of the environment-dependent variation in thermal background scene permits security personnel to set appropriate alarm criteria for the IDS on a daily or seasonal basis, as required.

MP 3178

EFFECT OF LOW TEMPERATURE ON DYNAMIC TENSILE STRENGTH OF ROCKS.

Dutta, P.K., Kim, K.S., International Symposium on Mining in the Arctic, 2nd, Fairbanks, AK, July 19-22, 1992. Proceedings. Edited by S. Bandopadhyay and M.G. Nelson, Rotterdam, A.A. Balkema, 1992, p.61-69, 16 refs.

47-1233

LOW TEMPERATURE TESTS, DYNAMIC LOADS, STRAIN TESTS, TENSILE PROPERTIES, TEMPERATURE EFFECTS, ROCK MECHANICS, FROZEN ROCK STRENGTH, ROCK DRILLING

This paper discusses the stress-strain behavior, fracture strength, influence of low temperature, and energy absorption in the dynamic fracturing of a limestone and a granitic rock. Experiments were conducted with a special low-temperature split-Hopkinson pressure bar in the tensile strain rate regime of 80-100 strains/s. The tensile strength was determined by diametral compression of disc samples (Brazilian method) at -40 C and 24 C. Diametral strains to failure were monitored by high-speed digital oscilloscope to observe deformations at microsecond intervals. These data then were compared with the results from room and low-temperature quasi-static tests.

MP 3179

WHITE PHOSPHORUS POISONING OF WATERFOWL IN AN ALASKAN SALT MARSH.

Racine, C.H., et al, *Journal of wildlife diseases*, 1992, 28(4), p.669-673.

47-1235

WATER POLLUTION, ENVIRONMENTAL IMPACT, EXPLOSIVES, MILITARY FACILITIES, ANIMALS, WETLANDS, SOIL POLLUTION, UNITED STATES—ALASKA

The cause of the yearly death of an estimated 1,000 to 2,000 migrating dabbling ducks (*Anas* spp.) and 10 to 50 swans (*Cygnus buccinator* and *C. columbianus*) has remained a mystery for the last ten years in Eagle River Flats (ERF), a 1,000 ha estuarine salt marsh near Anchorage, AK, used for artillery training by the U.S. Army. The authors have gathered evidence that the cause of this mortality is the highly toxic, incendiary munition white phosphorus (P4). The symptoms of poisoning observed in wild ducks included lethargy, repeated drinking, and head shaking and rolling. Death was preceded by convulsions. Farm-reared mallards dosed with white phosphorus showed nearly identical behavioral symptoms to those of wild ducks that became sick in ERF. White phosphorus does not occur in nature, but was found in both the sediments where dabbling ducks and swans feed and in the gizzards of all carcasses collected in ERF. It is hypothesized that feeding waterfowl are ingesting small particles of the highly toxic incendiary munition P4 stored in the bottom anoxic sediments of shallow salt marsh ponds.

MP 3180

CHEMICAL POTENTIAL OF A LAYER OF WATER ADSORBED ON A SOLID SURFACE.

Takagi, S., *Journal of colloid and interface science*,

Oct. 1992, 153(2), p.521-528, 16 refs.

47-1236

ICE WATER INTERFACE, THERMODYNAMICS, SURFACE ENERGY, ENTHALPY, WETTABILITY, MATHEMATICAL MODELS, WATER FILMS, LIQUID SOLID INTERFACES, ADSORPTION

The author presents the equilibrium thermodynamics of a layer of water adsorbed on a wettable solid. It seems reasonable to express the adsorption potential with the integration of the van der Waals potential of the power -6 over a given domain of the solid material. First the theory is developed for a layer of water adsorbed on an ice sphere. The theory is then extended to a layer of water adsorbed on a wettable solid of any shape. The chemical potential inside the adsorption layer includes the pressure of water, i.e., the disjoining pressure introduced by Derjaguin. The vapor/water interface, if it exists, can be located by solving the differential equation that the formula of the chemical potential valid on the interface produces when the water pressure is equated to the capillary pressure expressed in terms of the curvature of the surface. The constant that defines the van der Waals potential can be expressed with the material constants if the water is overlaid by the vapor. The importance of the disjoining pressure for causing a flow of adsorbed water is recognized. The theory applies to any liquid that wets a solid surface.

MP 3181

ICE IMPACTS ON FLOW ALONG THE MISSOURI RIVER.

Wuebben, J.L., Daly, S.F., White, K.D., Tatinclaux, J.C., Zufelt, J.E., IAHR Symposium on Ice, 11th, Banff, Alberta, June 15-19, 1992. Proceedings. Vol.3, 1992, 10p., 4 refs.

47-1237

ICE COVER EFFECT, DAMS, RESERVOIRS, WATER RESERVES, RIVER ICE, ICE JAMS, RIVER FLOW, FLOOD CONTROL, UNITED STATES—MISSOURI RIVER

In recent years, drought conditions in the Missouri River basin have required more accurate control of releases at Gavins Point Dam, the furthestmost downstream flow control structure on the river, in order to meet competing water needs for irrigation and recreation upstream and for navigation and municipal and industrial water supply downstream. In winter, ice accumulations can seriously affect flow distribution along the river. This paper summarizes a study of such ice effects. It proposes methods to determine minimum flow releases at Gavins Point Dam to meet downstream water supply without unduly depleting upstream reservoirs.

MP 3182

ISRAEL RIVER ICE CONTROL STRUCTURE.

Axelsson, K.D., Annual conference, 15th, Denver, CO, June 10-14, 1991. Proceedings, Madison, WI, Association of State Floodplain Managers, 1991, p.349-352, 4 refs.

47-1238

FRAZIL ICE, FLOOD CONTROL, RIVER ICE, ICE JAMS, ICE CONTROL, UNITED STATES—NEW HAMPSHIRE

MP 3183

ICE JAM FLOOD FREQUENCY ANALYSIS TECHNIQUES.

Zufelt, J.E., Wuebben, J.L., Annual conference, 15th, Denver, CO, June 10-14, 1991. Proceedings, Madison, WI, Association of State Floodplain Managers, 1991, p.353-356, 2 refs.

47-1239

RIVER ICE, ICE JAMS, FLOOD FORECASTING

MP 3184

OBSERVATION AND MEASUREMENT OF ICE MOVEMENT AND SEDIMENT TRANSPORT ON THE ST. MARYS RIVER DURING EARLY OPENING OF NAVIGATION 15-31 MARCH 1992.

Zabilansky, L.J., Frankenstein, G.E., Tuthill, A.M., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, 1992, 76p., 10 refs.

47-1240

SEDIMENT TRANSPORT, BANKS (WATERWAYS), CHANNEL STABILIZATION, DOCKS, LOCKS (WATERWAYS), RIVER ICE, ICE NAVIGATION, SHORE EROSION, UNITED STATES—MICHIGAN—ST. MARYS RIVER

MP 3185

THICKNESS PROFILING OF FRESHWATER ICE USING A MILLIMETER-WAVE FM-CW RADAR.

Yankielun, N.E., Arcone, S.A., Crane, R.K., *IEEE transactions on geoscience and remote sensing*, Sep. 1992, 30(5), p.1094-1100, 13 refs.

47-1262

PROFILES, SCATTERING, DESIGN, LAKE ICE, RIVER ICE, ICE COVER THICKNESS, ICE SURVEYS, AIRBORNE RADAR, RADAR ECHOES, PERFORMANCE

A prototype broadband millimeter wave (26.5 to 40 GHz) FM-CW radar employing digital signal processing techniques has been developed for profiling the thickness of freshwater ice. The radar was tested at elevations of up to 7 m above ice surfaces and at speeds up to 40 km/h both from a surface vehicle and a helicopter. The thickness of pond and river ice sheets between 3 and 35 cm thick with and without fresh snow cover and minimal surface roughness showed direct correlation with borehole thickness measurements. Losses due to volume scattering by imbedded air bubbles did not significantly affect system capability to discern the air/ice and ice/water scattering boundaries.

MP 3186

DISCUSSION OF "MINIMIZATION OF FRAZIL-ICE PRODUCTION BY RIVER FLOW REGULATION".

Ferrick, M.G., *Journal of hydraulic engineering*, Oct. 1991, 117(10), p.1406-1409, 3 refs. For paper being discussed see 44-120.

47-1286

FLOW CONTROL, RIVER FLOW, ICE FORMATION, ICE GROWTH, RIVER ICE, FRAZIL ICE, ICE CONTROL

MP 3187

DISCUSSION OF "MINIMIZATION OF FRAZIL-ICE PRODUCTION BY RIVER FLOW REGULATION".

Calkins, D.J., *Journal of hydraulic engineering*, Oct. 1991, 117(10), p.1402-1405, 8 refs. For paper being discussed see 44-120.

47-1287

FLOW CONTROL, RIVER FLOW, ICE FORMATION, ICE GROWTH, RIVER ICE, FRAZIL ICE, ICE CONTROL

MP 3188

STUDY OF ICE-COVERED BEND FLOW.

Tsai, W.F., Iowa City, University of Iowa, 1991, 207p., University Microfilms order No.DA9217216, Ph.D. thesis. 83 refs.

47-1314

RIVER ICE, ICE WATER INTERFACE, SUSPENDED SEDIMENTS, ALLUVIUM, CHANNELS (WATERWAYS), MATHEMATICAL MODELS, ICEBOUND RIVERS, RIVER FLOW, ICE COVER EFFECT, SEDIMENT TRANSPORT

MP 3189

ECOLOGY OF SEA ICE BIOTA. 1. HABITAT, TERMINOLOGY, AND METHODOLOGY.

Horne, R., et al, *Polar biology*, Sep. 1992, 12(3-4), p.417-427, Refs. p.424-427.

47-1334

SEA ICE, ECOLOGY, CRYOBIOLOGY

Polar regions are covered by extensive sea ice that is inhabited by a variety of plants and animals. The environments where the organisms live vary depending on the structure and age of the ice. Many terms have been used to describe the habitats and the organisms. The authors here characterize the habitats and communities and suggest some standard terms for them. They also suggest routine sampling methods and reporting units for measurements of biological and chemical variables. (Auth.)

MP 3190

ECOLOGY OF SEA ICE BIOTA. 2. GLOBAL SIGNIFICANCE.

Legendre, L., et al, *Polar biology*, Sep. 1992, 12(3-4), p.429-444, Refs. p.441-444.

47-1335

POLAR REGIONS, SEA ICE, ICE COVER EFFECT, CRYOBIOLOGY, ECOLOGY, ALGAE, WATER CHEMISTRY
Sea ice not only determines the ecology of ice biota, but also influences the pelagic systems under the ice cover and at ice edges. In this paper, new estimates of arctic and antarctic production of biogenic carbon are derived, and differences as well as similarities between the two oceans are examined. In ice-covered seas, high algal concentrations (blooms) occur in association with several types of conditions. Blooms often lead to high sedimentation of intact cells and faecal pellets. A fraction of the carbon fixed by microalgae that grow in sea ice or in relation to it is exported out of the production zone. This includes particulate material sinking out of the euphotic zone, and also material passed on to the food web. Pathways through which ice algal production does reach various components of the pelagic and benthic food webs, and through them such top predators as marine mammals and birds, are discussed. Processes that favor the production and accumulation of biogenic carbon as well as its export to deep waters and sequestration are discussed, together with those that influence mineralization in the upper ice-covered ocean. (Auth. mod.)

MP 3191

SHORT-PULSE RADAR DETECTION OF GROUNDWATER IN THE SAGAVANIRK TOK RIVER FLOODPLAIN IN EARLY SPRING.

Arcone, S.A., Chacho, E.F., Jr., Delaney, A.J., *Water resources research*, Nov. 1992, 28(11), p.2925-2936,

37 refs.

47-1475

ALIMENTATION, WATER SUPPLY, AERIAL SURVEYS, PROFILES, FLOODPLAINS, TALIKS, FROST MOUNDS, GROUND WATER, DETECTION, RADAR ECHOES

Short-pulse radar operating in the UHF band was used to search for unfrozen water beneath ice blisters and within the gravels of the Sagavanirktok River floodplain near Prudhoe Bay, AK. The investigations were carried out in early Apr. 1991, when daily mean air temperatures still were below -20°C. The radar pulse spectrum was centered near 400 MHz and the radar time range was set to cover about 10 m depth. The flat snow-covered surface allowed good antenna-ground coupling, and the ice and gravels provided a low-loss propagation medium that allowed details of the gravel structure to be seen in the data. Grids of several traverses were profiled at three sites, all within an area of about 0.5 sq km. Unfrozen water was inferred from the strength and polarization of the radar reflections. One site contained a large icing blister beneath which an extensive reservoir was mapped and seen to extend several tens of meters beyond the mound. Data from two other sites indicated taliks 5-7 m deep near a frozen mound and within the gravels. It is concluded that taliks exist in the floodplain throughout the winter and are a probable source for the numerous icing mounds seen along most arctic rivers east of Prudhoe Bay.

MP 3192

CLIMATE AND ENERGY EXCHANGE AT THE SNOW SURFACE IN THE ALPINE REGION OF THE SIERRA NEVADA. 1. METEOROLOGICAL MEASUREMENTS AND MONITORING.

Marks, D., Dozier, J., Davis, R.E., *Water resources research*, Nov. 1992, 28(11), p.3029-3042, 42 refs.

47-1476

WATERSHEDS, PERIODIC VARIATIONS, CLIMATOLOGY, ALPINE LANDSCAPES, SNOW SURFACE, SNOW HEAT FLUX, SNOWMELT, SNOW AIR INTERFACE, METEOROLOGICAL FACTORS, HEAT BALANCE

A detailed evaluation of climate conditions in a small alpine watershed is presented for the 1986 water year. Measurements of snowfall, meteorological and snow cover conditions, and snow cover ablation are used to characterize the climate at four locations in the watershed during that snow season. Data from these locations are then combined into two representative sites for the watershed. The data are integrated into a continuous hourly time series of solar and thermal radiation, air, snow and soil temperature, humidity, and wind at the sites for an entire snow season. While problems were encountered monitoring air and snow surface temperature, humidity, and wind because of the extreme conditions which are likely to occur in an alpine environment, radiation is easily monitored, and the estimated uncertainty of all measured parameters was acceptably low. This effort was required to develop a high quality time series of integrated climate data to evaluate the components of the energy balance of the snow cover during both deposition and ablation conditions.

MP 3193

ICE AND FOG: DETECTION AND WARNING SYSTEMS (NOV 83-PRESENT).

Whitney, C.M., Springfield, VA, U.S. National Technical Information Service, 1992, n.p., PB92-854504, Published search. 250 citations from the NTIS Bibliographic Database.

47-1495

ICE REPORTING, WARNING SYSTEMS, BIBLIOGRAPHIES, ICE DETECTION, FOG

MP 3194

STRENGTH DEVELOPMENT OF CONCRETE CURED AT LOW TEMPERATURE.

Korhonen, C.J., Cortez, E.R., Charest, B.A., *Concrete international*, Dec. 1992, 14(12), p.34-39, 6 refs. For another version see 46-349.

47-1560

TEMPERATURE CONTROL, TEMPERATURE EFFECTS, COLD WEATHER TESTS, WINTER CONCRETING, CONCRETE CURING, CONCRETE STRENGTH, CONCRETE ADMIXTURES, ANTIFREEZES

MP 3195

DETERMINATION OF SOIL MOISTURE DISTRIBUTION FROM IMPEDANCE AND GRAVIMETRIC MEASUREMENTS.

Ungar, S.G., Layman, R., Campbell, J.E., Walsh, J., McKim, H.L., *Journal of geophysical research*, Nov. 30, 1992, 97(D17), p.18,969-18,977, 7 refs.

47-1624

DESIGN, WATER CONTENT, SOIL WATER, SOIL SCIENCE, DIELECTRIC PROPERTIES, ELECTRICAL MEASUREMENT, PROBES, SOIL TESTS

Daily measurements of the soil dielectric properties at 5 and 10 cm were obtained at five locations throughout the First ISLSCP Field Experiment (FIFE) test site during the 1987 intensive field campaigns. An automated vector voltmeter was used to monitor the complex electrical impedance, at 10 MHz, of cylindrical vol-

umes of soil delineated by specially designed soil moisture probes buried at these locations. The objective of this exercise was to test the hypothesis that the soil impedance is sensitive to the moisture content of the soil and that the imaginary part (that is, capacitive reactance) can be used to calculate the volumetric water content of the soil. These measurements were compared with gravimetric samples collected at these locations by the FIFE staff science team. Examination of the data reveals that the impedance probe is a more consistent source of time series information than traditional measurements and is potentially more closely linked to the physical parameters which are both remotely sensed and required for surface energy/mass exchange determination.

MP 3196

COMPARISON BETWEEN WAVE PROPAGATION IN WATER-SATURATED AND AIR-SATURATED POROUS MATERIALS.

Albert, D.G., *Journal of applied physics*, Jan. 1, 1993, 73(1), p.28-36, 36 refs.

47-1678

ANALYSIS (MATHEMATICS), PHYSICAL PROPERTIES, REFLECTIVITY, SNOW ACOUSTICS, UNDERWATER ACOUSTICS, POROUS MATERIALS, SOUND WAVES, WAVE PROPAGATION, FLUID DYNAMICS, INTERFACES
Through use of classical Biot theory, propagation characteristics within water-filled and air-filled materials were compared in the 10 Hz-100 kHz band. Numerical calculations show that the ratio of fluid to solid motion for the slow compressional wave is around 2 in water-filled sand, but greater than 300 in air-filled sand. In addition, calculations of plane wave transmission from a fluid into a fluid-saturated porous solid show that when the fluid is water, nearly all of the incident energy is transferred to the reflected wave and to the transmitted fast compressional wave that is traveling mainly in the solid frame. Only a slight frequency dependence occurs in the energy transfer. When the fluid is air, however, the interaction of the waves with the boundary becomes strongly dependent upon frequency, and most of the incident energy is transferred to the reflected wave and to the transmitted slow compressional wave traveling mainly in the pores. These theoretical results justify the different approaches used to treat reflections from porous materials in underwater and aeroacoustics. For reflections, air-filled soil or snow can be approximately modeled as a modified fluid rather than as a viscoelastic solid, the approximation commonly used to model saturated undersea sediments.

MP 3197

PRELIMINARY ANALYSIS OF MEASURED SOUND PROPAGATION OVER VARIOUS SEASONAL SNOW COVERS.

Albert, D.G., International Symposium on Long-range Sound Propagation, 4th, Hampton, VA, May 16-17, 1990. Proceedings and NASA Conference Publication 3101, Hampton, VA, National Aeronautics and Space Administration, 1990, p.51-57, 7 refs.

47-1761

SEASONAL VARIATIONS, ATTENUATION, SNOW ACOUSTICS, SNOW COVER EFFECT, SOUND TRANSMISSION, WAVE PROPAGATION, ACOUSTIC MEASUREMENT

This paper details measurements of acoustic pulse propagation in the 5 to 500 Hz frequency band which were conducted under various snow cover conditions during the 1989-1990 winter in New Hampshire to determine the effect of snow cover thickness and other snow properties on the absorption of acoustic pulses. Blank pistol shots were used as the source of the acoustic waves, and geophones and microphones in an 80 m long linear array served as receivers. Snow thicknesses ranged from 0.05 to 0.35 m, and densities varied from 100 to 350 kg/cu m during the 10 separate measurement days. An automatic fitting procedure for the normalized experimental and theoretical waveforms was used to determine the effective flow resistivity of the snow covers, and gave values in agreement with earlier results.

MP 3198

OVERVIEW OF SEA ICE PHYSICAL PROPERTIES AND THEIR VARIABILITY.

Richter-Menge, J.A., Perovich, D.K., *SPIE—The International Society for Optical Engineering. Proceedings*, 1992, Vol.1750, Ocean optics XI, p.486-497, 40 refs.

47-1808

ALBEDO, ICE GROWTH, BRINES, SEA ICE, VARIATIONS, PHYSICAL PROPERTIES, OPTICAL PROPERTIES, ICE CRYSTAL OPTICS, REMOTE SENSING

An understanding of the physical properties of sea ice and their variability is critical both to interpret observations of the optical properties and to develop models of radiative transfer. Sea ice has an intricate structure consisting of platelets of fresh ice with inclusions of brine and air. These inclusions strongly affect the optical properties. The physical properties of the ice are highly dependent on the growth conditions and the seasonal evolution of the ice. Consequently, the state and structure of the ice exhibit large spatial and temporal variability. For example, the crystal texture can be granular or columnar, while crystal sizes can vary from millimeters to a few centimeters. Observed brine volumes

can vary from 0% in the surface layer of multi-year ice to as much as 50% in the skeletal layer at the bottom of a growing ice sheet. Densities show a similar variability, ranging from 0.60 to 0.92 g/cu cm. Because of this variability there is a need to use the large body of ice property observations to develop ice property models, either of an empirical or physical nature.

MP 3199

LIGHT REFLECTION FROM A SEA ICE COVER DURING THE ONSET OF SUMMER MELT.

Perovich, D.K., Govoni, J.W., *SPIE—The International Society for Optical Engineering. Proceedings*, 1992, Vol.1750, Ocean optics XI, p.508-516, 11 refs.

47-1809

ICE MELTING, SURFACE PROPERTIES, SEA ICE, REMOTE SENSING, ALBEDO, ICE OPTICS, REFLECTIVITY, LIGHT SCATTERING

Spectral measurements of albedo, bidirectional reflectance function, and polarized reflectance were made for sea ice conditions found during the onset of melt in the Canadian Arctic. The wavelength region studied was from the ultraviolet to the near infrared (370-1000 nm). Results for five surface types are presented: a) dry snow, b) dry snow with a glazed surface, c) bare ice, d) blue ice, and e) a melt pond. Results indicate that spectral albedos decrease at all wavelengths as the melt season progresses and the surface conditions evolve from a) through e), and that the decrease is most pronounced at longer wavelengths. Reflectance data suggest that a) at most angles reflectance has the same spectral shape as albedo, b) at 30 deg elevation reflectance is for the most part azimuthally isotropic and c) at 60 deg elevation a significant specular component was evident at 0 deg azimuth, especially for the bare ice case.

MP 3200

DEVELOPMENT OF FIELD SCREENING METHODS FOR TNT, 2,4-DNT AND RDX IN SOIL.

Jenkins, T.F., Walsh, M.E., Annual Environmental Research and Development Symposium, 16th, Williamsburg, VA, June 23-25, 1992. Proceedings, Aberdeen, MD, U.S. Army Corps of Engineers, 1992, p.33-45, Report No.CETHA-TS-CR-92063, 18 refs. For another version see 46-3066.

47-1819

CHEMICAL ANALYSIS, WASTE DISPOSAL, SOIL POLLUTION, EXPLOSIVES, SOIL ANALYSIS, SOIL TESTS, DETECTION

Simple field-screening methods are presented for detecting 2,4,6-TNT, 2,4-DNT and RDX in soil. Concentrations of TNT, 2,4-DNT and RDX are estimated from their absorbances at 540, 570 and 507 nm, respectively. Detection limits are about 1 microgram/g for 2,4,6-TNT and RDX, and about 2 microgram/g for 2,4-DNT. Concentration estimates from field analyses correlate well with laboratory analyses.

MP 3201

REVIEW OF CURRENT AND POTENTIAL FUTURE SAMPLING PRACTICES FOR VOLATILE ORGANIC COMPOUNDS IN SOIL.

Hewitt, A.D., Annual Environmental Research and Development Symposium, 16th, Williamsburg, VA, June 23-25, 1992. Proceedings, Aberdeen, MD, U.S. Army Corps of Engineers, 1992, p.75-82, Report No.CETHA-TS-CR-92063, 9 refs.

47-1820

CHEMICAL ANALYSIS, SOIL POLLUTION, SOIL TESTS, SAMPLING, ACCURACY, CORE SAMPLERS

This study compares two sampling and handling methods for the collection of soils to be analyzed for volatile organic compounds (VOCs). One method, which may be incorporated into future protocols, uses a simple subcoring device that allows set volumes of soil to be removed rapidly from the surrounding substrate and transferred to a tared analysis vessel, that a) can be analyzed via needle-septum puncture, b) attaches to a purge-and-trap system, or c) contains methanol. This less disruptive method not only limits mechanical fracturing during collection and lengthy sample exposure while transferring, but avoids soiling of the collection vessel seals. The findings show that, in order to acquire more accurate VOC concentrations in vadose zone soils, there is a need to limit disruptive and exposure practices.

MP 3202

COMBINED CREEP AND YIELD MODEL OF ICE UNDER MULTIAXIAL STRESS.

Fish, A.M., International Offshore and Polar Engineering Conference, 2nd, San Francisco, June 14-19, 1992. Proceedings. Vol.2. Edited by M.S. Triantafyllou, J.S. Chung, K. Karal, and A.L. Tunik, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1992, p.740-749, 37 refs.

47-1869

ICE SOLID INTERFACE, ICE PRESSURE, ICE MODELS, MATHEMATICAL MODELS, ICE COVER STRENGTH, ICE CREEP, ICE DEFORMATION, ICE LOADS

A combined creep and yield model has been developed for ice in a multiaxial stress state. The equations of the model describe the entire creep process, including primary, secondary, and tertiary creep, at both constant stresses and constant strain rates in terms of normalized (dimensionless) time $t=t/t_m$. Secondary creep is considered an inflection point defining the time to failure (t_m). The minimum strain rate at failure is described by a modified Norton-Glen power equation, which, as well as the time to failure, includes a parabolic yield criterion. The yield criterion is selected either in the form of an extended von Mises-Drucker-Prager or an extended Mohr-Coulomb rupture model. The criteria take into account that at a certain magnitude of mean normal stresses (σ_{max}) the shear strength of ice reaches a maximum value due to local melting of ice. The model has been verified using test data on yield of polycrystalline ice at -11.8 C and on creep of saline ice at -5 C, both under triaxial compression ($\sigma_{max} = \sigma_{min}$).

MP 3203

PRELIMINARY RESULTS OF THE U.S. NAVY LOCALIZED ICE IMPACT TEST PROGRAM.

Devine, E.A., Sodhi, D.S., International Offshore and Polar Engineering Conference, 2nd, San Francisco, June 14-19, 1992. Proceedings, Vol.2. Edited by M.S. Triantafyllou, J.S. Chung, K. Karal, and A.L. Tunik, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1992, p.750-763, 26 refs.

47-1870

METAL ICE FRICTION, ICE EDGE, SHIPS, MILITARY EQUIPMENT, MILITARY OPERATION, IMPACT TESTS, ICE LOADS, ICE SOLID INTERFACE, ICE PRESSURE, ICE NAVIGATION

A naval surface ship scale-model ice impact test program has been completed. Under this program, towed scale-models of the USCGC *Polar Sea* and a conceptual naval frigate were equipped with a specialized sensor which permitted the measurement of localized loads resulting from impact to urea-ice scale-model floes. The *Polar Sea* tests were performed for validation of the test procedures through comparison with full-scale test data available for this ship. The frigate tests are intended for validation of analytical loads models to be used for future structural design and operational assessments of U.S. Navy surface ships.

MP 3204

REVIEW OF RECENT FINDINGS IN WELL-CASING STUDIES.

Parker, L.V., Annual Environmental Research and Development Symposium, 16th, Williamsburg, VA, June 23-25, 1992. Proceedings, Aberdeen, MD, U.S. Army Corps of Engineers, 1992, p.83-91, Report No.CETHA-TS-CR-92063, 19 refs.

47-1892

MONITORS, CHEMICAL ANALYSIS, DEGRADATION, LEACHING, GROUND WATER, WATER POLLUTION, SAMPLING, WELL CASINGS, MATERIALS, STABILITY

For some time regulatory agencies have been concerned about 1) whether casing and screen materials used in groundwater-monitoring sorb or leach analytes of interest and 2) the resistance of these materials to degradation by the environment. This paper reviews recent findings on the suitability of several types of well casings for groundwater-monitoring applications.

MP 3205

VAPOR DIFFUSION COEFFICIENT FOR SNOW.

Colbeck, S.C., *Water resources research*, Jan. 1993, 29(1), p.109-115, 23 refs.

47-1903

MATHEMATICAL MODELS, TEMPERATURE EFFECTS, MASS TRANSFER, POROSITY, SNOW PHYSICS, WATER VAPOR, VAPOR DIFFUSION, SNOW PERMEABILITY, ICE VAPOR INTERFACE

The coefficients of diffusion for water vapor in snow and other porous media are fundamental parameters of great importance. While they are generally thought to be greater than the coefficient for air, there is much uncertainty about what value to use. Attempts to determine the diffusion coefficient in snow experimentally have led to contradictory results, but Yosida's experiments seem to give reasonable results. Yosida's idea of hand-to-hand diffusion is quantified here in a particle-to-particle model which shows that the diffusion coefficient depends on the mean pore size, and that the coefficient in snow is four to seven times greater than in air.

MP 3206

UNSURFACED ROAD MANAGEMENT RATING SYSTEM.

Eaton, R.A., Darling, M., *APWA reporter*, Jan. 1993, p.25, 4 refs.

47-1911

ROAD MAINTENANCE, CLASSIFICATIONS, URBAN PLANNING, COMPUTER PROGRAMS

MP 3207

DEPENDENCE OF POST-STABLE FLUIDELASTIC BEHAVIOR ON THE DEGREES-OF-FREEDOM OF A TUBE BUNDLE.

Lever, J.H., Rzentkowski, G., ASME Symposium on Flow-induced Vibration and Noise, Vol.2, New York, American Society of Mechanical Engineers, 1992, p.167-187, PVP-Vol.242, Refs. p.185-187.

47-1913

ANALYSIS (MATHEMATICS), OSCILLATIONS, DESIGN CRITERIA, HEAT PIPES, PIPES (TUBES), FLUID FLOW, STABILITY, STRUCTURAL ANALYSIS, TURBULENT FLOW

MP 3208

RIVER AND LAKE ICE CONDITIONS AS INTERPRETED FROM MICROWAVE IMAGERY.

Melloh, R.A., Gatto, L.W., Army Science Conference, June 22-25, 1992. Proceedings, Vol.2, U.S. Department of the Army, 1992, p.381-395, 16 refs.

47-1914

SURFACE STRUCTURE, POLARIZATION (WAVES), CLASSIFICATIONS, RIVER ICE, RADAR PHOTOGRAPHY, LAKE ICE, ICE CONDITIONS, MICROWAVES, SYNTHETIC APERTURE RADAR, RADIOMETRY, IMAGE PROCESSING, SENSOR MAPPING

This study has resulted in several findings that will be useful for imagery analysis of the surface features of frozen lakes and rivers: active radar systems provide the capability to distinguish rough-textured from smooth-ice covers, zones of variable ice surface roughness within rough ice fields can be differentiated, C- and L-band data are more sensitive than P-band to the range of surface roughnesses encountered, and polarization synthesis and signatures provide a way to improve contrast of ice features on radar imagery. Ka-band passive microwave systems allow the differentiation of wet versus dry snow conditions, open water in ice-covered rivers and lakes, and compacted areas in depth hoar snowpacks. Possible applications of these results include location of river bridging sites, dangerous thin-ice zones, packed-snow trails, and preferential water supply points.

MP 3209

APPLICATION OF INFINITE ELEMENTS TO PHASE CHANGE SITUATIONS ON DEFORMING MESHES.

Sullivan, J.M., Jr., O'Neill, K., *International journal for numerical methods in engineering*, 1992, Vol.33, p.1861-1874, 21 refs.

47-1915

WASTE TREATMENT, RADIOACTIVE WASTES, MATHEMATICAL MODELS, TEMPERATURE DISTRIBUTION, PHASE TRANSFORMATIONS, BOUNDARY VALUE PROBLEMS, HEAT TRANSFER, SOLIDIFICATION, SOIL FREEZING, ARTIFICIAL FREEZING

In this paper the advantages of time dependent mesh adaption for the solution of phase change problems are enhanced by the joining of a new formulation for infinite elements to far boundaries. This is accomplished through a co-ordinate transformation within the framework of conventional 2-D quadratic, biquadratic, and linear-quadratic elements. Standard 2 by 2 Gauss-Legendre quadrature suffices throughout and normal Galerkin finite element features are undisturbed, including strict conservation of energy. The formulation is independent of global co-ordinates, entails no restrictions on the unknown function and should be applicable to other problem types. All test cases on quadrilateral and triangular grids show very significant improvements with infinite elements relative to comparable solution systems using strictly finite grids.

MP 3210

ON: "AN ANALYTICAL STUDY OF A TWO-LAYER TRANSIENT THERMAL CONDUCTION PROBLEM AS APPLIED TO SOIL TEMPERATURE SURVEYS" BY T.H. LARSON AND A.T. HSUI.

Lunardini, V.J., Larson, T.H., Hsui, A.T., *Geophysics*, Dec. 1992, 57(12), p.1644-1645, 4 refs. For paper under discussion see 46-4484.

47-2001

ACCURACY, PERMAFROST HEAT TRANSFER, ANALYSIS (MATHEMATICS), SOIL TEMPERATURE, THERMAL CONDUCTIVITY, HEAT CAPACITY

MP 3211

DEVELOPMENT OF A WHEELED RUNWAY FOR MCMURDO ON THE ROSS ICE SHELF.

Blaisdell, G.L., Klokov, V.D., Diemand, D., Cambridge, England, Scientific Committee on Antarctic Research, 1992, 31p., 14 refs. Presented to the Standing Committee on Antarctic Logistics and Operations (SCALOP), at the 22nd meeting of SCAR, San Carlos de Bariloche, Argentina, June 15-19,

1992.

47-2120

SNOW COMPACTION, COLD WEATHER CONSTRUCTION, ICE (CONSTRUCTION MATERIAL), SNOW (CONSTRUCTION MATERIAL), LOGISTICS, AIRPLANES, ICE RUNWAYS, ICE SHELVES, ICE COVER STRENGTH, ANTARCTICA—MCMURDO STATION

The U.S. Antarctic Program currently operates aircraft from an annual sea ice runway at McMurdo until about Dec. 15th of each year. After that time it is limited to use of a snow runway and ski-wheel aircraft. Large cargo aircraft of this type are very specialized and in short supply. On the Ross Ice Shelf near McMurdo, an experimental runway to support heavy wheeled aircraft has been constructed. This runway capitalizes on the natural characteristics of the location and uses only snow and ice for construction materials. Such a runway is appealing because of its ability to support heavy wheeled cargo aircraft while requiring a relatively small construction and maintenance effort, and causes only minimal impact to the site. The runway is located inside the transition zone between the accumulation and ablation regions on the ice shelf. It uses a thin permanent cap of snow over natural blue ice to a) level undulations in the underlying surface, and b) protect the ice from intense solar radiation during the peak of summer (to prevent subsurface melt-pool formation). The snow cap was produced by compaction with a heavy roller during the warmest part of the year and the snow was then left to sinter and strengthen with falling temperatures. In early Feb. the snow cover was strong enough to support wheeled operation of a fully loaded LC-130.

MP 3212

PENETRATION OF ROCKS BY CONTINUOUS WATER JETS.

Harris, H.D., Mellor, M., International Symposium on Jet Cutting Technology, 2nd, Cambridge, England, Apr. 2-4, 1974, Bedford, England, British Hydromechanics Research Association, [1974], p.H1/1-H1/15, 4 refs.

47-2200

PENETRATION TESTS, ROCK DRILLING, HYDRAULIC JETS

Data on the penetration of Berea sandstone, Indiana limestone and Barre granite by continuous water jets are presented and discussed. These data do not confirm the existence of a threshold pressure, and there is a high sensitivity of penetration to low traverse speeds. Several schemes for achieving large penetrations are presented.

MP 3213

CHEMICAL THERMODYNAMICS OF CATION EXCHANGE REACTIONS: THEORETICAL AND PRACTICAL CONSIDERATIONS.

Grant, S.A., Fletcher, P., Ion exchange and solvent extraction; a series of advances. Vol.2. Edited by J.A. Marinsky and Y. Marcus, New York, Marcel Dekker Inc., 1993, p.1-108, 106 refs.

47-2222

CHEMICAL PROPERTIES, SOLUTIONS, LIQUID PHASES, MATHEMATICAL MODELS, ION EXCHANGE, THERMODYNAMICS, LIQUID SOLID INTERFACES, SOLID PHASES

MP 3214

TENSILE STRENGTH OF UNIDIRECTIONAL FIBER COMPOSITES AT LOW TEMPERATURES.

Dutta, P.K., Japan-U.S. Conference on Composite Materials, June 22-24, 1992, [1992], p.782-792, 23 refs.

47-2230

TENSILE PROPERTIES, RESINS, COLD STRESS, COMPOSITE MATERIALS, POLYMERS, LOW TEMPERATURE TESTS

Results of a number of tests by others and the author show that the longitudinal tensile strength of unidirectional-fiber-reinforced polymer composites degrades at low temperatures. The reason for this behavior is not obvious. Assuming that, to begin with, the fibers are curved, and when embedded in the resin they continue to maintain the curvature to a certain degree, an examination of the problem at low temperatures is presented. The critical fiber stress of such curved fibers is shown to be temperature dependent. Higher critical stress at lower temperatures is thought to be the possible reason of the strength degradation.

MP 3215

RELATIONSHIP BETWEEN SEA ICE FREEBOARD AND DRAFT IN THE ARCTIC BASIN, AND IMPLICATIONS FOR ICE THICKNESS MONITORING.

Wadhams, P., Tucker, W.B., Krabill, W.B., Swift, R.N., Comiso, J.C., Davis, N.R., *Journal of geophysical research*, Dec. 15, 1992, 97(C12), p.20,325-20,334, 41 refs.

47-2344

ICE SURVEYS, CORRELATION, SENSOR MAPPING,

ANALYSIS (MATHEMATICS), SEA ICE, SURFACE ROUGHNESS, PRESSURE RIDGES, ICE COVER THICKNESS, AERIAL SURVEYS, LASERS, SNOW COVER EFFECT

MP 3216

METEOROLOGICAL SURVEYS IN SUPPORT OF ICE AIRFIELDS IN ANTARCTICA.

Hogan, A.W., Stearns, C.R., Weidner, G.A., Conference on Polar Meteorology and Oceanography, 3rd, Portland, OR, Sep. 29-Oct. 2, 1992, Boston, American Meteorological Society, 1992, p.42-43, 9 refs. 47-2375

SITE SURVEYS, ICE AIR INTERFACE, WIND FACTORS, ICE RUNWAYS, METEOROLOGICAL FACTORS, ANTARCTICA—HOWE, MOUNT

Meteorological analysis indicates that katabatic winds, accelerating downslope from the polar plateau, erode snow cover to expose glacial ice at these places. The associated katabatic warming reduces the relative humidity of the near-surface air, facilitates ablation of the ice surface, and maintains dryness. Pebbles of 5 cm diameter are dispersed about the smooth ice surface proposed for use as a runway near Mt. Howe, the site nearest the South Pole. The movement of these rocks from the nearby exposed ground is evidence of occasional strong winds. The authors briefly describe some current observations, analysis of fragmentary data from recent and historic visits to the area, and their analytical approach to establishing the length of meteorological summer in this region.

MP 3217

CLUES TO CAUSES OF DEFORMATION FEATURES IN COASTAL SEA ICE.

Kozo, T.L., Fett, R.W., Farmer, L.D., Sodhi, D.S., *Eos*, Sep. 8, 1992, 73(36), p.385,388-389, 19 refs. 47-2597

ICE MECHANICS, ICE FLOES, AIR ICE WATER INTERACTION, SEA ICE DISTRIBUTION, REMOTE SENSING, RADIOMETRY, ICE DEFORMATION, DRIFT, STRESS CONCENTRATION

MP 3218

HARD ROCK TUNNELING MACHINE CHARACTERISTICS.

Mellor, M., Hawkes, I., Rapid Excavation and Tunneling Conference, Chicago, June 5-7, 1972. Proceedings. Vol.2, 1972, p.1149-1158, 8 refs. 47-2614

ROCK EXCAVATION, CONSTRUCTION EQUIPMENT, MACHINERY, TUNNELING (EXCAVATION), ROCK DRILLING

MP 3219

SOLVENT/WATER PARTITIONING OF DIMETHYLMETHYLPHOSPHONATE (DMMP) AS A PROBE OF SOLVENT ACIDITY.

Leggett, D.C., *Journal of solution chemistry*, 1993, 22(3), p.289-296, 17 refs. 47-2624

CHEMICAL PROPERTIES, ANALYSIS (MATHEMATICS), SOLUTIONS, SOLUBILITY, SALT WATER, CHEMICAL COMPOSITION, CHEMICAL ANALYSIS, PROBES

Experimentally determined partition coefficients for DMMP between NaCl-saturated water and 20 solvents were correlated using solvatochromic parameters. An inverted linear solvation energy relationship (LSER) was then used to predict the alpha scale for 7 additional solvents. The partition method appears to be a useful adjunct to solvatochromic techniques in refining and extending the alpha scale of solvent acidity, and could be used to rationalize solvent selection in extraction processes.

MP 3220

USE OF FALLING WEIGHT DEFLECTOMETER (FWD) TO CHARACTERIZE SEASONAL VARIATION IN PAVEMENT RESPONSE.

Janoo, V.C., Berg, R.L., Bigl, S.R., Tomita, H., Road Engineering Association of Asia and Australasia, 7th Conference, Singapore, June 22-26, 1992. Vol.2, 1992, p.395-404, 8 refs. 47-2628

ROAD ICING, RUNWAYS, FROST RESISTANCE, COLD WEATHER PERFORMANCE, ROAD MAINTENANCE, TRAFFICABILITY, FREEZE THAW TESTS, PAVEMENTS, FROST ACTION, THAW WEAKENING

In the northern U.S., pavements are subjected to several freeze-thaw cycles each year. During thawing periods, the pavement structure may become saturated from the thawing ice lenses or from infiltration of water from the pavement surface. If the pavement structure has inadequate drainage, undrained conditions can exist when loads are applied to the pavement. It has been reported that up to 90% of the damage to the pavement structure occurs during these thaw-weakened periods. The thaw-weakened periods in the U.S. may be considered analogous to periods during and after the rainy seasons in Asia and Australia. Essentially during the thaw or rainy season period, the moisture content in the

pavement structure increases. The methods developed for the thaw-weakening period can be applied in areas where pavement strength variations are caused by periodic changes in rainfall. The Corps of Engineers and the Federal Aviation Administration are conducting research to characterize the pavement response during thaw-weakening periods. The falling weight deflectometer has been used for this purpose. Falling weight deflection testing has been conducted on full-scale test sections under environmentally controlled conditions and in the field under natural conditions. Both roadway and airport pavements have been studied. The results show that the deflection data can be used to describe the pavement performance during the thaw (wet) periods. This paper presents an overview of the results from falling weight deflectometer testing in areas experiencing freeze-thaw cycles. Some of the parameters that may be used to characterize pavement performance during wet periods will be presented. A mechanistic pavement evaluation procedure for pavements in seasonal frost areas is being developed at CRREL. The results from this evaluation procedure are also presented.

MP 3221

SHIFTS IN ICE SHEET TEMPERATURES.

Colbeck, S.C., *Journal of geophysical research*, Mar. 20, 1993, 98(D3), p.5115-5120, 23 refs. 47-2855

ANALYSIS (MATHEMATICS), GLACIER HEAT BALANCE, ICE SHEETS, ICE TEMPERATURE, TEMPERATURE VARIATIONS, SNOW COVER EFFECT, RADIATION ABSORPTION, SUBSURFACE INVESTIGATIONS, ICE HEAT FLUX, SNOW AIR INTERFACE

This paper examines the phenomenon through which the entire temperature gradient in an ice sheet can be shifted by processes that occur just below the surface. Energy absorbed close to the surface flows back to the surface, which steepens the average temperature gradient near the surface and shifts the entire temperature profile to higher values. Various sources are considered, as are density profiles and transients. While some sources can increase the 10 m temperature in ice sheets, air currents flowing through snow can either heat or cool the snow at depth and can dominate all other processes. The relative contributions of the different mechanisms must be evaluated for any particular site. (Auth. mod.)

MP 3222

ABRUPT INCREASE IN GREENLAND SNOW ACCUMULATION AT THE END OF THE YOUNGER DRYAS EVENT.

Alley, R.B., et al, *Nature*, Apr. 8, 1993, 362(6420), p.527-529, 27 refs. 47-2892

SNOW ACCUMULATION, ICE CORES, CLIMATIC CHANGES, MODELS, GREENLAND

Results are presented from a new Greenland ice core (GISP2) showing that snow accumulation doubled rapidly from the Younger Dryas event to the subsequent Preboreal interval, possibly in one to three years. It is also found that the accumulation-rate change from the Oldest Dryas to the Bölling/Allerød warm period was large and abrupt. The extreme rapidity of these changes in a variable that directly represents regional climate implies that the events at the end of the last glaciation may have been responses to some kind of threshold or trigger in the North Atlantic climate system. (Auth. mod.)

MP 3223

PHYSICAL PROPERTIES OF SEA ICE RELEVANT TO REMOTE SENSING.

Tucker, W.B., Perovich, D.K., Gow, A.J., Weeks, W.F., Drinkwater, M.R., *American Geophysical Union. Geophysical monograph series*, 1992, No.68, Microwave remote sensing of sea ice. Edited by F.D. Carsey, p.9-28, 73 refs. 47-3016

SEA ICE, ICE SURFACE, ICE DENSITY, ICE GROWTH, ICE CRYSTAL STRUCTURE, ICE SALINITY, ICE COVER THICKNESS, SNOW ICE INTERFACE, REMOTE SENSING, ICE SURVEYS, ICE ELECTRICAL PROPERTIES, SEA WATER FREEZING, ICE STRUCTURE

In this chapter, the authors have attempted to illuminate aspects of sea ice that are believed to affect microwave remote sensing. In doing so, it was necessary to delve in some detail into certain processes, such as ice growth and its dynamic and thermal modifications. This was done primarily to provide a brief background useful in understanding the state of the ice at various stages in its history. Although the physical properties of sea ice have been studied for many years, they have recently taken on new significance due largely to increased remote sensing of the polar regions. While the emphasis has been to characterize and understand properties important to remote sensing, the increased attention to ice properties has enabled one to better understand properties and processes in their own right. This process is expected to continue as sensors are continually refined. (Auth. mod.)

MP 3224

PASSIVE MICROWAVE SIGNATURES OF SEA ICE.

Eppler, D.T., Farmer, L.D., Lohanick, A.W., Mellor, H.

R.A., *American Geophysical Union. Geophysical monograph series*, 1992, No.68, Microwave remote sensing of sea ice. Edited by F.D. Carsey, p.47-71, 78 refs. 47-3018

SNOW ICE INTERFACE, ICE OPENINGS, POLYNIES, ICE DETECTION, REMOTE SENSING, MICROWAVES, RADIOMETRY, ICE SURVEYS, ICE ELECTRICAL PROPERTIES, ICE SURFACE, SEA ICE DISTRIBUTION

MP 3225

MICROWAVE SEA ICE SIGNATURE MODELING.

Winebrenner, D.P., Gow, A.J., Perovich, D.K., *American Geophysical Union. Geophysical monograph series*, 1992, No.68, Microwave remote sensing of sea ice. Edited by F.D. Carsey, p.137-175, 70 refs. 47-3022

ICE SURFACE, ICE COVER THICKNESS, ICE SALINITY, ICE DENSITY, SNOW ICE INTERFACE, ICE MODELS, REMOTE SENSING, MICROWAVES, BACKSCATTERING, MATHEMATICAL MODELS, ICE SURVEYS, SEA ICE DISTRIBUTION, ICE ELECTRICAL PROPERTIES

MP 3226

LABORATORY INVESTIGATIONS OF THE ELECTROMAGNETIC PROPERTIES OF ARTIFICIAL SEA ICE.

Swift, C.T., et al, *American Geophysical Union. Geophysical monograph series*, 1992, No.68, Microwave remote sensing of sea ice. Edited by F.D. Carsey, p.177-200, 21 refs. 47-3023

SEA ICE, ARTIFICIAL ICE, YOUNG ICE, ICE GROWTH, ICE SALINITY, SNOW ICE INTERFACE, ICE COVER THICKNESS, ICE SURFACE, LABORATORY TECHNIQUES, ICE SURVEYS, ICE ELECTRICAL PROPERTIES, SEA WATER FREEZING, ICE STRUCTURE

MP 3227

MICROWAVE REMOTE SENSING OF THE SOUTHERN OCEAN ICE COVER.

Comiso, J.C., Grenfell, T.C., Lange, M.A., Lohanick, A.W., Moore, R.K., Wadhams, P., *American Geophysical Union. Geophysical monograph series*, 1992, No.68, Microwave remote sensing of sea ice. Edited by F.D. Carsey, p.243-259, 44 refs. 47-3026

ICE EDGE, ICE SALINITY, ICE TEMPERATURE, ICE COVER THICKNESS, ICE SURFACE, SNOW ICE INTERFACE, SPACEBORNE PHOTOGRAPHY, REMOTE SENSING, MICROWAVES, RADIOMETRY, ICE SURVEYS, SEA ICE DISTRIBUTION, ICE ELECTRICAL PROPERTIES, ANTARCTICA

The physical and radiative characteristics of sea ice in the antarctic region have not been as extensively studied as in the arctic, because the former is generally more inaccessible. However, there have been some antarctic programs, mostly in the Weddell Sea, with good *in-situ* measurements, that have been used to advance the knowledge of the microwave characteristics of antarctic sea ice. In this chapter, the basic physical, radiative and backscatter properties of sea ice in the southern ocean are presented. Also, techniques used to derive geophysical parameters, including ice extent and concentration from space-based systems, are evaluated.

MP 3228

OVERVIEW OF SNOW LOADS FOR FAIRBANKS, ALASKA.

Tobiasson, W., Greatorex, A., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, Dec. 1992, SR 92-27, International Conference on Snow Engineering, 2nd, Santa Barbara, CA, June 21-26, 1992. Edited by W. Tobiasson and E. Wright, p.393-404, 14 refs. 47-3217

SNOW SURVEYS, SNOW DEPTH, SNOW WATER EQUIVALENT, DESIGN CRITERIA, STANDARDS, SNOW LOADS, ROOFS, BUILDING CODES, COLD WEATHER CONSTRUCTION, UNITED STATES—ALASKA—FAIRBANKS In the 1970s design roof snow loads for Fairbanks, AK, ranged from 1.4 kPa (30 psf) to 3.1 kPa (65 psf) among the various "local experience" guidelines available. Three studies done between 1973 and 1978 provided a statistical basis for new guidance. The range of values was less among these new guidelines but differences persisted. Heavy snows during the 1990-91 winter caused several roofs to collapse and existing snow load design criteria to be questioned. Measurements were made of ground and roof snow loads during these record snows and meteorological information was updated and reanalyzed. The updated database indicated that the 50-year ground snow load should be 2.9 kPa (60 psf). Observations and measurements of snow on the ground and on roofs indicated that the 0.6 factor in the equation used to convert ground loads to roof loads should be increased to 0.7 for

roofs in the Fairbanks area. Winter winds in that area are quite low. Because the design snowpack is quite deep, it is not considered necessary to add a rain-on-snow surcharge load to roof snow loads. Rain has already been included in the water equivalent measurements used to establish the 2.9 kPa (60 psf) ground snow load.

MP 3229

PERCEPTIVE: MECHANICAL PROPERTIES AND BEHAVIOR.

Tobiasson, W., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, Dec. 1992, SR 92-27, International Conference on Snow Engineering, 2nd, Santa Barbara, CA, June 21-26, 1992. Edited by W. Tobiasson and E. Wright, p.479-480.

47-3227

SNOW LOADS, AVALANCHE ENGINEERING, SNOW THERMAL PROPERTIES, SNOW MECHANICS, SNOW REMOVAL, SNOW STRENGTH

MP 3230

THICKNESS MEASUREMENTS OF ARCTIC MULTIYEAR ICE.

Tucker, W.B., Sea Ice Thickness Workshop, New Carrollton, MD, Nov. 19-21, 1991. Report. Edited by A.S. Thorndike, C. Parkinson, and D.A. Rothrock, Seattle, University of Washington, Applied Physics Laboratory, Oct. 1992, p.B5-B9, 3 refs.

47-3241

ICE CORES, DRILL CORE ANALYSIS, SNOW ICE INTERFACE, ICE COVER THICKNESS, SEA ICE DISTRIBUTION, ICE SURVEYS

MP 3231

ACCURACY OF SUBMARINE ICE DRAFT MEASUREMENTS.

Tucker, W.B., Anderson, R., Newton, J., Wales, C., Newton, G., Luallin, T., Sea Ice Thickness Workshop, New Carrollton, MD, Nov. 19-21, 1991. Report. Edited by A.S. Thorndike, C. Parkinson, and D.A. Rothrock, Seattle, University of Washington, Applied Physics Laboratory, Oct. 1992, p.B22-B24, 4 refs.

47-3245

SUBGLACIAL OBSERVATIONS, ICE ACOUSTICS, UNDERWATER ACOUSTICS, SUBMARINES, ICE COVER THICKNESS, SEA ICE DISTRIBUTION, ICE SURVEYS, ICE BOTTOM SURFACE

MP 3232

REMOTE MEASUREMENT OF SEA ICE THICKNESS USING ELECTROMAGNETIC SOUNDING.

Kovacs, A., Sea Ice Thickness Workshop, New Carrollton, MD, Nov. 19-21, 1991. Report. Edited by A.S. Thorndike, C. Parkinson, and D.A. Rothrock, Seattle, University of Washington, Applied Physics Laboratory, Oct. 1992, p.B52-B54, 1 ref.

47-3250

ICE ELECTRICAL PROPERTIES, AIRBORNE RADAR, AERIAL SURVEYS, RADIO ECHO SOUNDINGS, ICE COVER THICKNESS, SEA ICE DISTRIBUTION, ICE SURVEYS

MP 3233

STANDING SEAM METAL ROOFING SYSTEMS IN COLD REGIONS.

Tobiasson, W., Buska, J., Conference on Roofing Technology, 10th, Gaithersburg, MD, Apr. 22-23, 1993. Proceedings. Problems: issues and answers, Rosemont, IL, National Roofing Contractors Association, 1993, p.34-44, 15 refs.

47-3542

THERMAL EXPANSION, VENTILATION, WATERPROOFING, JOINTS (JUNCTIONS), ROOFS, COLD WEATHER CONSTRUCTION, COLD WEATHER PERFORMANCE, SNOW SLIDES, SNOW LOADS, ICICLES
Standing seams that are out of the "flood plain" and sliding clips that allow metal panels to expand and contract thermally have significantly improved the performance of metal roofing systems. By fixing the metal panels to the frame only at the eaves, differential movements do not occur at that vulnerable location where all water drains, snow and ice may slide and ice dams may form. When water ponds on metal roofs behind icicles and ice dams, the risk of leaks increases greatly. Such risks can be reduced by using "waterproof" (not "water shedding") systems, by increasing the slope, by reducing the overhang at the eaves, by increasing the amount of roof or attic insulation, and by ventilating between that insulation and the metal to create a "cold" roof. Since it is difficult to properly ventilate a metal roof with a slope of 2 in./ft. or less, there is incentive to use greater slopes in cold regions. Most metal roofing systems are not ventilated, but in cold regions, ven-

tilation may be needed to reduce the risk of condensation problems and ice damming. Small, infrequent ice dams along the eaves of "cold" metal roofs seldom create problems. When large dams develop at the eaves, it may be necessary to install electric heaters. The tendency for snow and ice to slide off slippery metal roofs complicates the installation of electric de-icing systems and may create hazards. Snow guards are needed on some metal roofs to prevent snow and ice from sliding.

MP 3234

WATER RESOURCE MODELLING USING REMOTE SENSING AND OBJECT-ORIENTED SIMULATION.

McKim, H.L., Cassell, E.A., LaPotin, P.J., *Hydrological processes*, 1993, Vol.7, p.153-165, 16 refs.

47-3346

HYDROLOGY, WATER RESERVES, REMOTE SENSING, RUNOFF FORECASTING, COMPUTERIZED SIMULATION, COMPUTER PROGRAMS, SNOWMELT, WATER-SHEDS

MP 3235

INFERRING SNOW COVER ON SEA ICE FROM PASSIVE MICROWAVE SIGNATURES.

Lohanick, A.W., WMO Operational Ice Remote Sensing Workshop, 2nd, Ottawa, Sep. 10-13, 1991. Abstracts and papers. Vol.1, Ottawa, Environment Canada, Dec. 1991, p.119-124.

47-3380

RADIOMETRY, ICE SURVEYS, SNOW SURVEYS, SNOW ICE INTERFACE

MP 3236

BEAUFORT SEA ICE-1: AN OVERVIEW.

Livingstone, C.E., Kovacs, A., WMO Operational Ice Remote Sensing Workshop, 2nd, Ottawa, Sep. 10-13, 1991. Abstracts and papers. Vol.1, Ottawa, Environment Canada, Dec. 1991, p.189-205.

47-3386

SYNTHETIC APERTURE RADAR, RADAR TRACKING, ICE SURVEYS, SEA ICE DISTRIBUTION, ICE SURFACE, ICE COVER THICKNESS, BEAUFORT SEA

MP 3237

POLYNOMIAL TREND SURFACE ANALYSIS APPLIED TO AVHRR IMAGES TO IMPROVE DEFINITION OF ARCTIC LEADS THROUGH BINARY SEGMENTATION PROCEDURES.

Eppler, D.T., Full, W.E., WMO Operational Ice Remote Sensing Workshop, 2nd, Ottawa, Sep. 10-13, 1991. Abstracts and papers. Vol.2, Ottawa, Environment Canada, Dec. 1991, p.161-189, 15 refs.

47-3406

RADIOMETRY, IMAGE PROCESSING, COMPUTER APPLICATIONS, STATISTICAL ANALYSIS, ICE SURVEYS, SEA ICE DISTRIBUTION, ICE OPENINGS, ICE DETECTION, ICE WATER INTERFACE, ICE CONDITIONS

Polynomial trend surface analysis was applied to three AVHRR images to determine whether regional trends in image radiance can be removed with this procedure. Results suggest that trend surface techniques can be effective in removing region-scale variation in image radiances. Optimum results are achieved when the third- and fourth-order surfaces are subtracted to remove local temperature and illumination anomalies that occur at smaller spatial scales, primarily in the vicinity of clouds. Application of higher-order surfaces fails to improve image quality. There is some indication that the topography of these higher-order surfaces in part maps regional variation in lead density. Use of a best-fit criterion based on a strict variance technique (such as the least-squares method) to define the trend surface limits the effectiveness of the technique in this application. A criterion that allows for data to be weighted based on their distance from the plane about which they cluster is more appropriate to the structure of AVHRR radiance data typical of images that show sea ice. A criterion that incorporates a rule system based on fuzzy logic offers an alternative means of assessing goodness-of-fit that might prove appropriate in this application.

MP 3238

MOISTURE RESEARCH IN NORTH AMERICA.

Bomberg, M.T., Tobiasson, W., Research and development in building physics during the last 25 years, Stockholm, Swedish Council for Building Research, 1992, p.57-93, Refs. passim.

47-3451

RESEARCH PROJECTS, BIBLIOGRAPHIES, THERMAL INSULATION, BUILDINGS, MOISTURE TRANSFER, VAPOR BARRIERS, WATERPROOFING

MP 3239

PARTICLE TRANSPORT TO THE SNOW SURFACE AT THE SOUTH POLE: THE BEGINNING OF A TROPOSPHERIC HISTORY.

Hogan, A.W., Gow, A.J., *Tellus*, Apr. 1993, 45B(2),

p.188-207, Refs. p.205-207.

47-3536

SNOW COMPOSITION, PARTICLES, AEROSOLS, METEOROLOGICAL FACTORS, ANTARCTICA—AMUNDSEN-SCOTT STATION

Sodium concentration measurements in recent south polar snow have been compared with surface aerosol measurements made at the Amundsen-Scott Station. When a 180-day lag is applied to allow spring/summer aerosols to be precipitated and incorporated into the autumn/winter snow layer, very good correspondence exists between mean aerosol concentration in air and mean sodium concentration in snow. This paper describes analyses of meteorological and glaciological processes to define glaciological and meteorological years, which justify the use of this 180-day lag. Precipitation of sodium and other particles through coagulation and other ice crystal attachment processes is discussed relative to the meteorological year. The results indicate that additional measurements relative to the gradients of temperature, wind, precipitation, and accumulation on the Polar Plateau are essential to the formal establishment of a theory relating glaciological accumulation to meteorological processes, and formulating tropospheric history from glacial deposition. (Auth. mod.)

MP 3240

COMMENTS ON "THE DENSITY OF NATURAL ICE ACCRETIONS RELATED TO NON-DIMENSIONAL ICING PARAMETERS" BY K.F. JONES.

Levi, L., Prodi, F., Jones, K.F., *Royal Meteorological Society. Quarterly journal*, Apr. 1993, 119(511), p.599-609, 13 refs. Includes reply. For paper under comment see 44-3570.

47-3646

ICE ACCRETION, METEOROLOGICAL FACTORS, HOAR-FROST, CLOUD DROPLETS, ICE DENSITY, ANALYSIS (MATHEMATICS), ICE FORECASTING, HEAT FLUX, ACCURACY

MP 3241

SLUDGES FROM COLD REGIONS LAGOONS.

Schneider, R.W., Middlebrooks, E.J., Sletten, R.S., Reed, S.C., *Water environment research*, Mar.-Apr. 1993, 65(2), p.146-155, 37 refs.

47-3675

WASTE TREATMENT, WATER TREATMENT, PONDS, COLD WEATHER OPERATION, SLUDGES, CHEMICAL COMPOSITION, SEDIMENTATION, TEMPERATURE EFFECTS

MP 3242

MARINE GEOLOGIC INVESTIGATIONS OF DISENCHANTMENT BAY, ALASKA, AFTER BREAKUP OF 1986 HUBBARD GLACIER ICE DAM.

Carlson, P.R., Powell, R.D., Cowan, E.A., Lawson, D.E., *U.S. Geological Survey. Open-file report*, 1992, No.92-706, 41p., 24 refs.

47-3708

COASTAL TOPOGRAPHIC FEATURES, GLACIAL LAKES, MORAINES, SUBSURFACE INVESTIGATIONS, ICE DAMS, LAKE BURSTS, GLACIER OSCILLATION, BOTTOM SEDIMENT, BOTTOM TOPOGRAPHY, UNITED STATES—ALASKA—HUBBARD GLACIER

MP 3243

MESOSCALE SIMULATION OF THE ARCTIC ICE PACK.

Hopkins, M.A., Ice mechanics—1993. Edited by J.P. Dempsey, Z.P. Bazant, Y.D.S. Rajapakse, and S. Shyam Sunder, New York, American Society of Mechanical Engineers, 1993, p.85-96, 16 refs.

47-3744

ICE FLOES, ICE OPENINGS, PRESSURE RIDGES, ICE COVER STRENGTH, ICE COVER THICKNESS, ICE MODELS, COMPUTERIZED SIMULATION, MATHEMATICAL MODELS, ICE DEFORMATION, PACK ICE, SEA ICE DISTRIBUTION

The large-scale processes and properties of the arctic ice pack depend on the granular nature of the pack, particularly on the size and distribution of areas of thin ice and open water surrounding multiyear ice floes. Global climate models and ice-ocean models of the Arctic Basin depend on the use of continuum approximations to define the internal strength of the ice pack, the ice thickness distribution, the surface roughness, and the amount of ridging and lead creation under a given deformation field. At present, empirical data on which to base the continuum approximations are scarce. To obtain better estimates of continuum approximations characterizing the ice pack, a mesoscale (10-100 km) numerical model of the central arctic ice pack has been developed. The mesoscale model is based on a dynamic particle simulation in which individual multiyear ice floes and surrounding areas of first-year ice are explicitly modeled as discrete, convex polygons in a two-dimensional control area. Deformation of the control area produces regions of localized failure and areas of open water. The regions of localized failure are modeled as pres-

sure ridging events using the results of numerical experiments performed with a computer simulation of the ridging process. Initial experiments performed with the model provide crude estimates of the strength of the arctic ice pack and the redistribution of ice thicknesses under various strain fields.

MP 3244

INDENTATION AND SPLITTING OF FRESH-WATER ICE FLOES.

Sodhi, D.S., Chin, S.N., Stanley, J.M., Ice mechanics—1993. Edited by J.P. Dempsey, Z.P. Bazant, Y.D.S. Rajapakse, and S. Shyam Sunder, New York, American Society of Mechanical Engineers, 1993, p.165-175, 15 refs.

47-3751

ICE FLOES, ICE PRESSURE, ICE LOADS, ICE DEFORMATION, ICE CRACKS, ICE BREAKING, ICE SOLID INTERFACE, ICE COVER STRENGTH

Small-scale indentation and floe-splitting experiments were conducted on columnar ice floes of various sizes and at different speeds. During low-speed indentation (0.2-8 mm/s), the ice floes always split apart, while at higher indentation speeds (>100 mm/s) they did not. The reason is attributed to differences in the process of deformation and failure. At low speed, a large zone of microcracked ice forms in front of the indenter. Development of compressive stresses in the microcracked ice zone leads to buildup of transverse forces that drive crack propagation. These zones of microcracked ice are not observed during high-speed indentation. Rather, the ice fails by continuous crushing. The theoretical effective pressure required to split an ice floe agrees to some extent with those measured during experiments.

MP 3245

EFFECT OF CREEP ON THE CONSTITUTIVE BEHAVIOR OF SALINE ICE AT LOW STRAINS.

Cole, D.M., Ice mechanics—1993. Edited by J.P. Dempsey, Z.P. Bazant, Y.D.S. Rajapakse, and S. Shyam Sunder, New York, American Society of Mechanical Engineers, 1993, p.261-271, 16 refs.

47-3759

ICE LOADS, SALT ICE, ICE MICROSTRUCTURE, ICE ELASTICITY, ICE DEFORMATION, ICE CREEP, ICE STRENGTH, ICE PRESSURE

This work examines changes in the cyclic loading response of saline ice brought about by creep deformation. The combination of cyclic and creep loading techniques provides a means to quantify the effects of creep damage on mechanical behavior. Although it is clearly important to quantify the microstructural damage associated with creep deformation, a complete understanding of the problem requires that the effects of that damage on constitutive behavior be understood as well. To address this issue, two types of loading sequences were applied to specimens of laboratory-grown ice. In the first the specimen was deformed to specific levels of total strain under constant-load creep conditions and allowed to fully recover upon unloading. A series of zero-mean-stress 0.1-Hz cyclic loads were applied prior to each creep loading and after the final creep loading. The second consisted of a single creep loading, with zero-mean-stress cycles being applied before and after the creep deformation. In addition, load cycles were superimposed on the creep stress at several points during the experiment. All experiments were performed at -10°C, with the creep stress being either 0.5 or 0.75 MPa, and the peak cyclic stress generally varied from 0.1 to 0.4 MPa in increments of 0.1 MPa. The creep results demonstrate the manner in which the anelastic strain builds to an apparent saturation level. The cyclic loading results indicate that the progressive creep damage has a consistent but minor effect in reducing the initial modulus. The specimen compliance, as indicated by the hysteresis loop width, increased monotonically and to a significant degree with increasing levels of creep strain. The experimental results are examined in detail and interpreted in a micromechanical context, with particular attention being paid to the anelastic processes.

MP 3246

SHOCK RESPONSE OF SNOW.

Johnson, J.B., Solie, D.J., Brown, J.A., Gaffney, E.S., *Journal of applied physics*, May 15, 1993, 73(10), p.4852-4861, 21 refs.

47-3794

SNOW PHYSICS, SNOW COMPACTION, SNOW DEFORMATION, SNOW DENSITY, IMPACT TESTS, SHOCK WAVES, WAVE PROPAGATION, LOADING, ATTENUATION, AVALANCHE MECHANICS

MP 3247

AERIAL ROOF MOISTURE SURVEYS.

Tobiasson, W., *APWA reporter*, June 1993, p.18-19.

47-3795

ROOFS, MOISTURE DETECTION, INFRARED PHOTOGRAPHY, AIRBORNE RADAR

MP 3248

DISCUSSION OF DEEP SNOW MOBILITY MODELS.

Richmond, P.W., Hanover, NH, U.S. Army Cold

Regions Research and Engineering Laboratory, 1993, 10p., 27 refs. Presented at the NATO Reference Mobility Model (NRM) Technical Management Committee Meeting, Trier, Germany, May 12-13, 1993.

47-3901

MOTOR VEHICLES, MATHEMATICAL MODELS, RUBBER SNOW FRICTION, SNOW STRENGTH, SNOW HARDNESS, TRACTION, TRAFFICABILITY

This report discusses deep snow mobility (trafficability) models. Investigations into the trafficability of vehicles in deep snow have been ongoing since as early as 1954. Modeling of vehicle performance under these conditions began shortly thereafter. Completely acceptable models have not yet been developed. The primary purpose of these models, as with all trafficability models, is to predict net traction. This is generally done by predicting the gross traction available to the vehicle and subtracting a prediction of the resistance to motion caused by the terrain. Vehicle sinkage is also a desirable value, to determine if the vehicle undercarriage is dragging (which will increase resistance), and to determine if the vehicle is truly in a deep snow condition. Recently, a shallow snow mobility model was developed that seems to produce excellent results. Due to the apparent lack of an acceptable deep snow model, it seemed reasonable to attempt some comparisons between shallow and deep snow algorithms and to compare the results with available data. A short description of deep snow is provided, and the basic algorithms and assumptions of various models are described and compared with each other and with test data. These results indicate that, of the models examined, sinkage can be predicted marginally well, but the extent of the deformation bulb cannot be determined. The shallow snow relationships for resistance and traction seem promising for use in deep snow, but more confirmation is required. The existing deep snow models require extensive snow characterization, which is acceptable for design comparisons, but not for use as tactical decision aids.

MP 3249

FIELD SCREENING METHODS FOR TNT, RDX AND 2,4-DNT IN SOIL AND WATER.

Jenkins, T.F., Walsh, M.E., Environmental Symposium and Exhibition, 19th, Albuquerque, NM, Mar. 22-25, 1993. Proceedings, Arlington, VA, American Defense Preparedness Association, 1993, p.282-287, 15 refs.

47-3912

SOIL CHEMISTRY, WATER CHEMISTRY, CHEMICAL ANALYSIS, SOIL POLLUTION, WATER POLLUTION, EXPLOSIVES, ENVIRONMENTAL IMPACT

Development and validation of field screening techniques for explosives residues in soil and water originating from munitions wastes are discussed. Simple colorimetric tests have been developed to detect 2,4,6-TNT, 2,4-DNT and RDX in soil water. Soils are extracted by manually shaking with acetone. Water samples are extracted by passage through a solid phase extraction cartridge and eluting with acetone. The acetone extracts from each procedure are then subjected to the following reactions. For TNT and 2,4-DNT, the extracts are reacted with potassium hydroxide and sodium sulfite to form the red-colored Janowsky complex when TNT is present or the blue-purple complex when 2,4-DNT is present. For RDX, extracts are passed through an anion exchange resin to remove nitrate and nitrite, acidified, and RDX is reduced with zinc to form nitrous acid. The nitrous acid is detected by reaction with a Hach Nitri Ver 3 powder pillow, which produces a highly colored azo dye. Detection of these analytes can be obtained visually and concentrations estimated from absorbance measurements at 540, 570 and 507 nm for TNT, 2,4-DNT and RDX, respectively. Detection limits in soil are about 1 microgram/g for TNT and RDX and about 2 microgram/g for 2,4-DNT. Detection limits in water have been estimated at 5 microgram/L for TNT and RDX. Results indicate that the field screening methods do not suffer from false negatives and the rate of false positives is low.

MP 3250

COMPARISON OF SOLID PHASE EXTRACTION WITH SALTING-OUT SOLVENT EXTRACTION FOR PRECONCENTRATION OF NITROAROMATIC AND NITRAMINE EXPLOSIVES FROM WATER.

Jenkins, T.F., Miyares, P.H., Environmental Symposium and Exhibition, 19th, Albuquerque, NM, Mar. 22-25, 1993. Proceedings, Arlington, VA, American Defense Preparedness Association, 1993, p.316-321, 19 refs.

47-3913

GROUND WATER, SOIL CHEMISTRY, WATER CHEMISTRY, CHEMICAL ANALYSIS, SOIL POLLUTION, WATER POLLUTION, EXPLOSIVES, ENVIRONMENTAL IMPACT Residues of high explosives are one of the most significant pollution problems at DOD facilities. Recently the EPA has lowered the concentration at which these compounds are thought to be harmful to human health. Because TNT, RDX and HMX, as well as several manufacturing impurities and environmental transformation products, are quite mobile in the soil and have caused ground water pollution, there is an increasing demand for low-level analysis of these compounds in ground water from installa-

tion boundary wells. RDX and HMX are very polar, and normal liquid-liquid extraction/preconcentration techniques result in poor recovery. Two innovative preconcentration techniques have been reported that appear to offer improved recovery and adequate preconcentration: solid phase extraction (SPE) and salting-out solvent extraction (SOE). This paper compares cartridge-SPE, membrane-SPE, and SOE using a series of reagent-grade water samples fortified with low concentrations of 11 nitroaromatics and nitramines and a set of ground water samples from an explosives-contaminated DOD facility. Results indicated that the three methods were comparable with respect to low-level detection capability, which ranged from 0.05 to 0.30 mg/L.

MP 3251

SEA ICE FLEXURAL RIGIDITY: A COMPARISON OF METHODS.

DiMarco, R.L., Dugan, J.P., Martin, W.W., Tucker, W.B., *Cold regions science and technology*, May 1993, 21(3), p.247-255, 16 refs.

47-3928

SEA ICE, ICE WATER INTERFACE, ICE MECHANICS, MECHANICAL TESTS, FLEXURAL STRENGTH, ELASTIC WAVES, WAVE PROPAGATION, ACCURACY, ANALYSIS (MATHEMATICS)

Mechanical properties of sea ice are typically determined from a static test using the physical and chemical properties of small samples. Measurements of flexural properties of multi-year sea ice were made recently using both a static and a dynamic geophysical technique. This paper presents the results of a comparison between the ice flexural rigidity determined by the two methods. The dynamic method is shown to yield a very precise determination of the flexural rigidity based upon the propagation of low frequency (1 to 70 Hz) waves. Values determined by the static method are shown to be consistently higher.

MP 3252

EFFECT OF FATIGUE ON THE BEARING CAPACITY OF FLOATING ICE SHEETS.

Haynes, F.D., Kerr, A.D., Martinson, C.R., *Cold regions science and technology*, May 1993, 21(3), p.257-263, 8 refs.

47-3929

FLOATING ICE, ICE COVER STRENGTH, BEARING STRENGTH, MECHANICAL TESTS, OSCILLATIONS, DYNAMIC LOADS, STATIC LOADS, CORRELATION, FATIGUE (MATERIALS)

In this paper laboratory tests on floating freshwater ice covers with specially built pulsators are described. Preliminary tests showed that the creep deflections were very small and that the pulsator used did not cause a breakthrough in the time frame considered. Therefore, a breakthrough method was used to determine the effect of the oscillatory load on the bearing capacity of an ice cover. After a prescribed time (or a number of accumulated cycles) both loading devices, the pulsator and its static control, were subjected to a constant downward deflection rate by means of screwjacks until breakthrough occurred. Two series of tests were conducted, one at an oscillating frequency of 21.5 Hz and the other at 15 Hz. Results of both series of tests showed that the oscillations substantially lowered the bearing capacity of the ice covers tested.

MP 3253

PROCEEDINGS OF THE 49TH ANNUAL EASTERN SNOW CONFERENCE, OSWEGO, NY, JUNE 3-4, 1992.

Eastern Snow Conference, Ferrick, M.G., ed, Pangburn, T., ed, 1992, 273p., Refs. passim. For individual papers see 47-4027 through 47-4058.

47-4026

SNOWSTORMS, SNOWFALL, SNOWMELT, SNOW HYDROLOGY, SNOW AIR INTERFACE, LAKE EFFECTS, RUNOFF, RIVER ICE

MP 3254

ACOUSTIC PULSE PROPAGATION OVER A SEASONAL SNOW COVER.

Albert, D.G., *Eastern Snow Conference. Proceedings*, 1992, 49th, p.47-53, 19 refs.

47-4032

SOUND TRANSMISSION, ATTENUATION, SEASONAL VARIATIONS, SNOW ACOUSTICS, SNOW COVER EFFECT, SNOW PERMEABILITY, SNOW AIR INTERFACE The absorption of sound energy by the ground has been studied extensively because of its importance in understanding noise propagation through the atmosphere. Snow is of interest in this regard because it is the most absorptive naturally occurring ground cover. To quantify the effect of snow, measurements of acoustic pulse propagation were conducted in the 5- to 500-Hz frequency band over various snow covers and over snow-free grass and frozen ground. Blank pistol shots fired 1 m above the snow surface were the source of the acoustic pulses, and geophones and microphones arranged in a linear array were used to record the resultant waveforms. The peak pulse amplitudes decayed much faster with distance over snow than over snow-free grass; an order of magnitude difference in the sound pressure levels was recorded after 100 m of propagation. The acoustic wave-

forms were also markedly changed after propagating over snow, with broadened pulses and enhanced low frequencies. The pulse shapes and peak amplitude decay rates were successfully predicted theoretically using a layered, rigid-frame, porous medium model of the snow. The effective flow resistivity of the snow was determined by matching theoretical and observed waveforms, and this method gives promise of becoming a useful method of estimating the intrinsic permeability of the snow.

MP 3255 INDUCED FLOW CHANNELS IN A NATURAL SNOWPACK.

Albert, M.R., McGilvary, W.R., Greenan, H.J., *Eastern Snow Conference. Proceedings*, 1992, 49th, p.55-60, 7 refs.

47-4033

RUNOFF, SNOWMELT, SNOW HYDROLOGY, SEEPAGE
Preliminary results from the response of two snowmelt lysimeters are examined in order to investigate the outflow differences between a disturbed and undisturbed natural snow cover. The lysimeters are located 5 m apart on level ground and are identical, except that one has instrumentation that induces vertical flow channels, while the other does not. The number of vertical flow paths in shallow, layered snowpacks has a large influence on snowmelt discharge. In ripe, homogeneous snowpacks with high discharge rates, induced vertical flow paths have little influence on discharge. Layering in shallow snow can influence snowmelt discharge through a significant portion of the snowmelt season.

MP 3256 CHARACTERIZATION OF HILLSLOPE THERMAL AND HYDROLOGIC PROCESSES AT THE SLEEPERS RIVER RESEARCH WATERSHED.

Pangburn, T., Albert, M.R., Hardy, J.P., McGilvary, W.R., Shanley, J.B., *Eastern Snow Conference. Proceedings*, 1992, 49th, p.161-167, 13 refs.

47-4045

SNOW HEAT FLUX, SEEPAGE, RUNOFF, SLOPE PROCESSES, WATERSHEDS, SNOWMELT, SNOW HYDROLOGY, SNOW THERMAL PROPERTIES
Measurements for the characterization of thermal and hydrologic processes at the hillslope scale were made within the W-9 subwatershed at the Sleepers River Research Watershed during the 1991-92 winter season. Three soil pits were instrumented on a predominantly south-facing slope with a deciduous cover type. Soil and snow temperature sensors, soil moisture sensors, and soil water lysimeters were installed at each pit. Meteorologic data (air temperature, relative humidity, wind speed and direction, incoming and reflected short- and long-wave radiation) and snowpack characteristics were also measured throughout the study period. Streamwater and streambed temperatures were measured at the toe of the slope. These data are being used to study hillslope-scale thermal and hydrologic processes as an intermediate scale between point and basin modeling. Results of this study suggest that source areas are best defined by a field accounting of the thermal mechanisms in the snow/soil/stream system. These observed thermal mechanisms have a large effect on the internal snowmelt processes, the relative flow paths of surface, subsurface and ground water and the total outflow to the stream channel.

MP 3257 STREAM COOLING BY HEAT TRANSFER TO PARTIALLY-SUBMERGED ROCKS.

Davis, R.E., *Eastern Snow Conference. Proceedings*, 1992, 49th, p.193-201, 25 refs.

47-4048

ICE WATER INTERFACE, HEAT TRANSFER, STREAMS, WATER TEMPERATURE, ROCK PROPERTIES, RIVER ICE, FREEZEUP, ICE FORMATION, ICE HEAT FLUX
This study tested the hypothesis that partially submerged rocks in small streams contribute significantly to the heat loss from the stream during icing episodes. The experiment took place in a small stream on the eastern border of the Sierra Nevada mountains in California. Thermistors were placed in granite and quartz monzonite rocks, and the rocks were placed along transects across the stream. Rock, stream and air temperatures were measured along with other meteorologic variables during freezing events. The components of the energy balance over the stream and heat transfer rates between the rocks and the stream were estimated. Exposed rocks in a pool reached temperatures below stream temperatures during icing events, particularly when the stream temperature dropped to the melting point of ice. The energy loss rates from the stream to some of the rocks were the same magnitude for short periods as the energy losses from the surface of the stream. On the other hand, rock temperatures closely tracked the stream temperatures during daily warming. Analysis of one of the freezing episodes is presented here.

MP 3258 DEVELOPMENT OF A FIELD TECHNIQUE FOR MEASURING FRESH WATER ICE DENSITY.

Mulherin, N.D., Ferrick, M.G., Weyrick, P.B., Peron, N.M., Hunnewell, S., *Eastern Snow Confer-*

ence. Proceedings, 1992, 49th, p.203-212, 9 refs.

47-4049

ICE SURVEYS, RIVER ICE, LAKE ICE, ICE DENSITY, ICE BREAKUP, ICE DETERIORATION
Warming and subsequent deterioration of river and lake ice during the spring thaw cause dramatic changes in its material properties. This paper investigates whether the ice porosity or, alternatively, the drained density can be quantified in the field. The accuracy and precision of field mass/volume measurement of cylindrical ice cores were obtained by comparing with mass/volume measurements made on the same samples after careful machining in the laboratory. In addition, some of the ice samples were later analyzed using a submersion weighing method that is highly accurate for bubble-free ice, and these results were compared with the two mass/volume methods. This preliminary analysis indicates that the field method may be adequate for characterizing both the spatial variability of ice density and the temporal changes in this density distribution.

MP 3259 LOCAL INFLUENCES ON WINTER MINIMUM AIR TEMPERATURES.

Hogan, A.W., Ferrick, M.G., *Eastern Snow Conference. Proceedings*, 1992, 49th, p.243-246, 7 refs.

47-4054

SURFACE TEMPERATURE, ATMOSPHERIC BOUNDARY LAYER, SOIL AIR INTERFACE, SNOW AIR INTERFACE, SNOW COVER EFFECT, AIR TEMPERATURE

Previous experiments have developed the hypothesis that a frozen, snow-covered river impoundment can provide an air temperature reference plane in complex terrain. This reference plane facilitates analysis of surface temperature variability and the temperature-height structure of the boundary layer with respect to slope and aspect in the vicinity of the plane. The authors apply these results to analysis of the influence of local surface snow cover on the morning air temperature, and the vertical temperature structure observed.

MP 3260 TIRE CHIPS AS INSULATION BENEATH GRAVEL SURFACED ROADS.

Humphrey, D.N., Eaton, R.A., Frost in geotechnical engineering. Edited by A. Phukan, Rotterdam, A.A. Balkema, 1993, p.137-149, 15 refs.

47-4132

ROAD ICING, ROAD MAINTENANCE, THERMAL INSULATION, FROST PROTECTION, WASTE DISPOSAL, GRAVEL

MP 3261 STATIC ANALYSIS OF FLOATING ICE BLOCK STABILITY.

Coutermarsh, B.A., McGilvary, W.R., *Journal of hydraulic research*, 1993, 31(2), p.147-160, With French summary. 7 refs.

47-4172

FLOATING ICE, STATIC STABILITY, MECHANICAL TESTS, ICE WATER INTERFACE, ICE BOTTOM SURFACE, FLUID DYNAMICS, WATER PRESSURE, TOPOGRAPHIC EFFECTS, ANALYSIS (MATHEMATICS)

A laboratory study was performed to measure the pressures caused by fluid acceleration beneath a floating parallelepiped block. Dynamic fluid pressure was measured at discrete points beneath the block for various fluid velocities, block angles of attack and block thickness-to-depth ratios. Some of these pressures tended to stabilize the block while others tended to overturn it. The measured pressures were used to calculate block overturning moments and a hydrostatic analysis was used to calculate a block righting moment. From this, a densimetric Froude overturning criterion is presented.

MP 3262 OBSERVATION OF RECURRENT TEMPERATURE LAPSE NEAR THE SURFACE AT THE SOUTH POLE.

Obreski, J.S., Samson, J.A., Barnard, S.C., Murphy, B.B., Hogan, A.W., *Conference on Polar Meteorology and Oceanography*, 2nd, Madison, WI, Mar. 29-31, 1988. Preprints, Boston, American Meteorological Society, 1988, p.145-147, 12 refs.

47-4204

POLAR ATMOSPHERES, AIR TEMPERATURE, SURFACE TEMPERATURE, TEMPERATURE INVERSIONS, SNOW AIR INTERFACE, ANTARCTICA—AMUNDSEN-SCOTT STATION

In Nov. 1983, a 30 m meteorological tower was erected at the South Pole to measure temperatures and winds. As used here, temperature lapse refers to the variation of temperature with height. Temperatures were measured in Jan. 1985 at the air-firn interface and at heights on the tower of 2, 6, 10, 14, 18, 22, and 26 m. The temperature minima often occurred several meters above the surface. Temperatures from day to day ranged from -18 to -28 C, but the temperatures usually varied less than a degree with height.

MP 3263 PROCEEDINGS. VOL.4. ARCTIC/POLAR TECHNOLOGY.

International Conference on Offshore Mechanics and Arctic Engineering, 12th, Glasgow, Scotland, June 20-24, 1993, Nixon, W.A., ed, Sodhi, D.S., ed, Sinha, N.K., ed, Ayorinde, O.A., ed, New York, American Society of Mechanical Engineers, 1992, 219p., Refs. passim. For individual papers see 47-4224 through 47-4249.

47-4223

ICE SOLID INTERFACE, ICE MECHANICS, ICE MODELS, ICE CRYSTALS, ICE CREEP, LOADING, IMPACT TESTS, ICE STRENGTH, ICE LOADS

MP 3264 ANALYSIS OF DATA FROM INDENTATION TESTS ON FRESHWATER ICE.

Chin, S.N., Sodhi, D.S., *International Conference on Offshore Mechanics and Arctic Engineering*, 12th, Glasgow, Scotland, June 20-24, 1993. *Proceedings*. Vol.4. Edited by W.A. Nixon, D.S. Sodhi, N.K. Sinha and O.A. Ayorinde, New York, American Society of Mechanical Engineers, 1993, p.73-81, 7 refs.

47-4233

ICE COVER STRENGTH, ICE MECHANICS, ICE SOLID INTERFACE, IMPACT TESTS

Indentation tests were conducted using a segmented indenter at different indentation velocities against freshwater ice. To determine the nature of ice failure at different rates, the effective pressure was measured on each segment of the indenter. The variation of pressure on each segment of the indenter was simultaneous at low-velocity indentation, whereas it was random during high-velocity indentation. Spectral and correlation plots of the data show that the degree of randomness in the measured pressure signal increased with an increase in indentation velocity. Plots of the mean, the maximum and the standard deviation of the measured pressure are given with respect to the indentation velocity and the aspect ratio. For brittle ice failure, the actual contact of the ice with the indenter is over many small contiguous zones where brittle flaking originates because of high pressure. The trends of decreasing standard deviation with increasing indentation velocity and increasing aspect ratio are attributed to a decrease in the size and an increase in the number of the failure zones, respectively.

MP 3265 BIO-OPTICAL OBSERVATIONS OF FIRST-YEAR ARCTIC SEA ICE.

Perovich, D.K., Cota, G.F., Maykut, G.A., Grenfell, T.C., *Geophysical research letters*, June 7, 1993, 20(11), p.1059-1062, 16 refs.

47-4266

MARINE BIOLOGY, SEA ICE, OPTICAL PROPERTIES, SOLAR RADIATION, LIGHT TRANSMISSION, ATTENUATION, SPECTRA, BIOMASS, SNOW COVER EFFECT

This paper presents the first direct *in situ* measurements of biomass specific diffuse attenuation spectra for arctic ice algae. The data show *in situ* attenuation values that are about 3 times larger than those obtained from corresponding *in vivo* absorption measurements, apparently reflecting differences in the geometrical distribution of the algae or the influence of skeletal ice and dissolved organic material. Observations also confirm that maximal algal accumulation occurs when there is a thin layer of snow covering the ice. A new technique to separate the effects of snow and algae in observed transmission spectra is presented. The ratio of transmittance between 600 nm and 450 nm is a sensitive indicator of biomass, while the 700 nm to 600 nm ratio is strongly affected by snow depth.

MP 3266 STRESS-STRAIN BEHAVIOUR OF FROZEN SOIL IN TENSION.

Sayles, F.H., *Canada-France Seminar—Gas Pipelines, Oil Pipelines and Civil Engineering in Arctic Climates*, Caen and Paris, France, Oct. 2-4, 1991. *Proceedings*. Edited by P.J. Williams, Ottawa, Carleton University, Geotechnical Science Laboratories, 1993, p.61-72, 4 refs.

47-4273

UNDERGROUND PIPELINES, FROST HEAVE, STRESS STRAIN DIAGRAMS, TENSILE PROPERTIES, SANDS, FROZEN GROUND MECHANICS

MP 3267 COMBINED CREEP AND YIELD MODEL OF ICE UNDER MULTIAXIAL STRESS.

Fish, A.M., *International journal of offshore and polar engineering*, June 1993, 3(2), p.130-138, 37 refs. For another version see 47-1869.

47-4298

ICE STRENGTH, ICE CREEP, ICE DEFORMATION, ICE MODELS, SHEAR STRAIN, STRAIN TESTS, MATHEMATICAL MODELS

MP 3268

APPLICATIONS OF ERS-1 SAR DATA FOR ANALYZING RIVERINE AND COASTAL PROCESSES AND GEOMORPHOLOGY.

Gatto, L.W., Calkins, D.J., Chacho, E.F., Jr., Lawson, D.E., Melloh, R.A., ERS-1 Symposium, Cannes, France, Nov. 4-6, 1992. Proceedings, Vol.2. Space at the service of our environment. Edited by B. Kaldeich, Paris, European Space Agency, 1993, p.873-878, ESA SP-359, 7 refs.

47-4449

GEOMORPHOLOGY, SPACEBORNE PHOTOGRAPHY, SYNTHETIC APERTURE RADAR, ICE SURVEYS, RIVER ICE, GLACIER ICE, WETLANDS, CORRELATION, PERFORMANCE, WATER SUPPLY

An objective in analyzing European Space Agency ERS-1 SAR images was to determine their utility in monitoring environmental conditions and processes important for managing water resources. This paper summarizes the initial analyses of such SAR images of various geomorphic features around Alaska. Patterns on SAR images are compared to those on Landsat images, and data from ground-penetrating radar and field observations is used to interpret the SAR images. These comparisons show that the ERS-1 SAR can locate unfrozen water beneath river and lake ice on the Sagavanirktok River floodplain; determine the general ice, snow and sediment conditions along the Matanuska Glacier; show general nearshore ice conditions and coastal geomorphology along Alaska's north shore, and delineate coastal wetlands vegetation along Knik Arm. These results suggest that the ERS-1 SAR imagery will be a valuable source of environmental data for addressing water supply in cold regions, for glacial monitoring, for coastal navigation and for assessing wetland conditions.

MP 3269

LAGOON SLUDGE DEWATERING BY NATURAL FREEZE-THAW.

Martel, C.J., Gagnon, B., Diener, C.J., Hardy, D.L., Joint CSCE-ASCE National Conference on Environmental Engineering, 2nd, Montreal, July 12-14, 1993. Proceedings. Vol.1. Edited by R.N. Yong, J. Hadjicicolaou, and A.M.O. Mohamed, Montreal, Canadian Society for Civil Engineering, 1993, p.357-364, 7 refs.

47-4477

SEWAGE DISPOSAL, SLUDGES, SOIL FREEZING, FREEZE THAW CYCLES, ARTIFICIAL FREEZING

This paper presents a new method of handling sludge from lagoons located in cold regions. This method involves an annual sludge removal operation and the use of a freezing bed for dewatering. It was evaluated at Fort Greely, AK, which has two lagoons containing up to 0.90 m of sludge. Drainage tests comparing frozen and unfrozen lagoon sludge indicated that natural freeze-thaw can significantly improve dewaterability. Filtrate quality was approximately equivalent to that of weak domestic wastewater. On the basis of sludge measurements and freezing depth calculations, the land area required for the freezing bed is 60 sq m. A demonstration of this method is planned at Fort Greely.

MP 3270

ROUGHNESS OF WEDDELL SEA ICE AND ESTIMATES OF THE AIR-ICE DRAG COEFFICIENT.

Andreas, E.L., Lange, M.A., Ackley, S.F., Wadhams, P., *Journal of geophysical research*, July 15, 1993, 98(C7), p.12,439-12,452, 44 refs.

47-4521

SEA ICE, ICE FLOES, CLASSIFICATIONS, SURFACE ROUGHNESS, SNOW SURFACE, PROFILES, SPECTRA, ICE AIR INTERFACE, ICE BOTTOM SURFACE, SNOW COVER EFFECT, REMOTE SENSING

The authors report snow surface, ice surface, and ice underside roughness, computed from 47 surface elevation profiles collected during a transect of the Weddell Sea. The roughness for each surface, parameterized as the standard deviation of the surface elevation, segregates according to whether or not a floe has been deformed: deformed ice has greater roughness than undeformed ice. Roughness spectra for all three surfaces and for both deformed and undeformed ice roll off roughly as $1/k$ when the wavenumber k is between 0.1 and 3 rad/m. The snow surface and underside spectra roll off somewhat faster than $1/k$, and the ice surface spectra roll off somewhat slower than $1/k$. It is likely that the excess spectral intensity at high wavenumbers in the antarctic ice surface spectra results from the small-scale roughness that the ice sheet had on consolidation. A remote measurement of roughness will facilitate the decision regarding degree of ice floe deformation. This spectral analysis hints that remote sensing may also be able to differentiate between first-year and second-year ice. From the snow surface spectra, a roughness scale parameter which combines the air-ice momentum coupling permits estimates of the neutral stability drag coefficient referenced to a height of 10 m. (Auth. mod.)

MP 3271

ICING PROBLEMS AT CORPS PROJECTS.

Haynes, F.D., Haehnel, R.B., Zabilansky, L.J., U.S. Army Corps of Engineers. *Waterways Experiment Station. Repair, Evaluation, Maintenance, and Rehabilitation Research Program. Technical report*, Apr. 1993, REMR-HY-10, 18p. + figs., 6 refs.

47-4608

RIVER ICE, ICE CONDITIONS, ICE CONTROL, ICE PREVENTION, ICE LOADS, ICING, LOCKS (WATERWAYS), DAMS, HYDRAULIC STRUCTURES

MP 3272

RADAR BACKSCATTER MEASUREMENTS FROM ARCTIC SEA ICE DURING THE FALL FREEZE-UP.

Beaven, S.G., Gogineni, S.P., Shanableh, M., Gow, A.J., Tucker, W.B., Jezek, K.C., *Kansas. University. Radar Systems and Remote Sensing Laboratory. Technical report*, Feb. 1993, RSL-TR-8241-1/8243-1, 66p., ADA-261 843, 7 refs.

47-4621

ICE SURVEYS, SEA ICE DISTRIBUTION, ICE DETECTION, DRIFT, ICE ELECTRICAL PROPERTIES, FREEZE-UP, RADAR TRACKING, BACKSCATTERING

MP 3273

RESPONSE OF AN ALASKA, U.S.A., SHRUB-TUSsock COMMUNITY TO SELECTED ALL-TERRAIN VEHICLE USE.

Ahlstrand, G.M., Racine, C.H., *Arctic and alpine research*, May 1993, 25(2), p.142-149, 18 refs.

47-4746

TUNDRA, SUBARCTIC LANDSCAPES, VEGETATION PATTERNS, PLANT ECOLOGY, ORGANIC SOILS, DAMAGE, ALL TERRAIN VEHICLES, ENVIRONMENTAL IMPACT, ENVIRONMENTAL TESTS, TERRAIN, UNITED STATES—ALASKA—WRANGELL MOUNTAINS

This paper examines the results of tests conducted at Wrangell-St. Elias National Park which quantified the effects of all-terrain vehicle (ATV) use on a shrub-tussock community. Vehicle track depth increased significantly with increasing passes. Vehicles running on rubber tires created deeper tracks than similar vehicles mounted on continuous rubber tracks. Heavier ATVs usually produced deeper tracks than lighter vehicles. Deeper tracks resulted when vehicle use was spread over a 10-wk period during the summer than when the passes were concentrated into shorter time periods near the beginning or end of the snow-free period. Two years after completing the treatments, most of the heavier-used lanes had subsided 2 to 4 cm due to thawing of ice-rich permafrost. Although injury occurred to shrubs continuously throughout the treatments, shrub injury rates were greatest during the first few passes by an ATV. The degree of sedge tussock compression and amount of organic soil exposed along the ATV tracks increased in relation to vehicle weight.

MP 3274

DIODE LASER HUMIDITY SENSOR FOR COLD ENVIRONMENTS. PHASE I. FINAL TECHNICAL REPORT.

Stanton, A.C., Silver, J.A., U.S. Army Cold Regions Research and Engineering Laboratory, Santa Fe, NM, Southwest Sciences, Inc., Mar. 1988, 35p., Contract No. DACA33-87-C-0028, 23 refs.

47-4861

HUMIDITY, HYGROMETERS, LASERS, METEOROLOGICAL INSTRUMENTS, COLD WEATHER PERFORMANCE, ATMOSPHERIC ATTENUATION, OPTICAL ABSORPTION, INFRARED SPECTROSCOPY

MP 3275

MEASUREMENT OF HEAT LOSSES FROM A CONDUIT-TYPE HEAT DISTRIBUTION SYSTEM.

Lunardini, V.J., Army Science Conference Proceedings, 12-15 June 1990, Volume II, Washington, D.C., Department of the Army, 1990, p.435-449, 5 refs.

47-4862

HEAT LOSS, HEAT TRANSFER, RADIANT HEATING, HEAT PIPES, MILITARY FACILITIES, COST ANALYSIS, MATHEMATICAL MODELS

It has been estimated that the Department of the Army has approximately 3,000 miles of energy-carrying conduits and the Department of Defense has approximately double this. A conservative estimate for the cost to the Army of energy losses from these conduits is \$90 million each year. Heat losses from buried conduit energy-distribution systems are not known with confidence, especially in regions of seasonal frost. Values used for design are based on calculation procedures that rely on unverified assumptions. The object of this study was to measure the heat losses from a full-scale buried conduit under controlled laboratory conditions. The data and calculated quantities could then be compared to the predicted heat losses using standard calculation methods.

MP 3276

RADIOSONDE SUPERCOOLED LIQUID WATER DETECTOR.

Hill, G.E., U.S. Army Cold Regions Research and Engineering Laboratory, Boulder, CO, Atek Data Corp., Sep. 1990, 97p., Contract No. DACA89-84-C-0005, Refs. passim.

47-4882

SUPERCOOLED CLOUDS, UNFROZEN WATER CONTENT, ICE DETECTION, AIRCRAFT ICING

A radiosonde icing detector consists of a vibrating wire placed in the humidity duct of a VIZ radiosonde. The wire is forced to vibrate at its natural frequency. As supercooled liquid water accumulates on the wire in the form of ice, the vibration frequency decreases according to the mass collected. This frequency is transmitted to a receiver along with the standard data. From the rate of change of frequency, the balloon rise speed and characteristics of the wire, the concentration of supercooled liquid water in clouds is found.

MP 3277

DEVELOPMENT OF A PORTABLE ICE-THICKNESS MEASURING INSTRUMENT. FINAL REPORT. PHASE I.

Adler, D., Jacobs, M., U.S. Army Cold Regions Research and Engineering Laboratory, Small Business Innovation Research Program, SBIR A 91-Q20, Amityville, NY, General Microwave Corporation, Mar. 1992, 28p., Contract No. DACA33-91-C-0035.

47-4883

ICE COVER THICKNESS, ICE ELECTRICAL PROPERTIES, ICE SURVEYS, ICE DETECTION, MICROWAVES, RADAR

General Microwave Corporation has performed a feasibility study on the application of a novel narrow-band radar technology to the measurement of ice thickness. Such an instrument is needed by the US Army. It also has potential commercial applications as a safety device for frozen lakes, as an analytical instrument to determine pavement conditions on highways, and as an aerospace sensor to measure icing conditions on airplanes. A laboratory prototype was designed, assembled, and tested during the Phase I effort. The targeted 0.5" resolution for ice thickness up to 24" was achieved. The narrow-band method permits the use of small size and simple components for a portable, cost-effective device.

MP 3278

DEVELOPMENT OF A PORTABLE ICE-MEASURING INSTRUMENT.

Doundoulakis, G.J., U.S. Army Cold Regions Research and Engineering Laboratory, Small Business Innovation Research Program, SBIR A91-Q20, North Bellmore, NY, Neotronics Corporation, Dec. 1991, 31p. + appends., Contract No. DACA33-91-C-0033, 10 refs.

47-4884

ICE COVER THICKNESS, ICE ACOUSTICS, ICE SURVEYS, ICE DETECTION, ACOUSTIC MEASUREMENT, ELECTRONIC EQUIPMENT

Under Phase I of an SBIR contract, Neotronics Corp. has completed a working breadboard, capable of providing LCD display of ice thickness from 2" to over 24" proving feasibility of the proposed concept. The breadboard uses a two-transducer array (0.4 Mhz), and reports more than one reading, each with its reliability level, between 1 and 3. The breadboard comprises, besides transducers: pulsing circuits for driving transducers; a transceiver chip for coupling transducer and electronic circuits; tuned echo-amplifying circuits; an interface circuit for digitizing and conveying signals to a microcontroller; external RAM for storing the microcontroller program; and LCD controller with 4-digit display for processing and displaying the computed ice thickness and reliability number. Two parts are envisioned in the finished equipment: the head, which is placed on the ice (about 8x8x4 inches) and a hand-held box (2.25x5x1.5 inches) providing control buttons and LCD display, besides cable for plugging into the head. Uses include measuring ice thickness over water, where children skate, or for transporting heavy loads, and of ice on airplane wings; measuring thicknesses of material with unknown sound velocity, such as cement or sediments (where it can help identify buried fossils); and measuring fluid density in fluid flow measurements.

MP 3279

PNEUMATICALLY DE-ICED ICE DETECTOR.

Franklin, C.H., Rogne, C.O., Vinton, C.S., U.S. Army Cold Regions Research and Engineering Laboratory, Ann Arbor, MI, Franklin Engineering Co., May 1985, 32p., Contract No. DACA89-84-C-0006, 20 refs.

47-4896

ICE DETECTION, POWER LINE ICING, ICE LOADS, ICE REMOVAL, ANEMOMETERS, COMPUTER PROGRAMS

The ice detector measures both the weight of ice forming on the collection cylinder and the wind effects on these ice formations in azimuth and torsional wind loads through the vertical axis of the

ice detector. These loads will be measured by a force transducer located between the collection probe and the mounting support housing. The pneumatically de-iced ice detector is designed to operate on 110 VAC or to be battery operated, and consumes very little power. The instrument's collection cylinder and mounting support are both pneumatically de-iced using gas-operated rubber boots. The pressure can be supplied by an air compressor or by a compressed dry nitrogen gas cylinder. The collection probe and support housing are de-iced periodically, depending on the weight of ice accumulated on the probe. In the de-iced condition, the instrument will measure wind direction and wind speed. The instrumentation package will time-code and record all functions of the ice detector.

MP 3280

MEASUREMENT OF HEAT LOSSES FROM AN OPERATING DISTRICT HEATING SYSTEM.

Phetteplace, G.E., *Fernwärme international*, 1992, 21(3), p.100-111, With German summary. 7 refs. 47-4897

HEAT LOSS, HEAT TRANSFER, RADIANT HEATING, HEAT PIPES, WATER PIPES, MILITARY FACILITIES

MP 3281

INVESTIGATIONS OF ACTIVE INFRARED DETECTION OF PAVEMENT ICING.

Rosen, D.I., Chen, C.J., *Physical Sciences Inc., Andover, MA. Technical report*, May 1989, PSI-2045/ TR-837, U.S. Army Cold Regions Research and Engineering Laboratory, 30p., Contract No. DACA33-87-C-0023, 1 ref. For earlier version see 41-3763. 47-4902

ROAD ICING, ICE DETECTION, ROAD MAINTENANCE, INFRARED EQUIPMENT

MP 3282

DEVELOPMENT OF ADVANCED INSTRUMENTATION FOR DROP SIZE AND LIQUID WATER CONTENT MEASUREMENTS IN CLOUDS.

Bachalo, W.D., Rudoff, R.C., Smith, J.N., U.S. Army Cold Regions Research and Engineering Laboratory, Sunnyvale, CA, Aerometrics, Inc., July 1988, 66p., Contract No. DACA33-87-C-0027, 23 refs. 47-4903

CLOUD DROPLETS, UNFROZEN WATER CONTENT, PARTICLE SIZE DISTRIBUTION, SHIP ICING, ICE FORECASTING

The objective of this program is the development of a portable and rugged probe for the determination of drop size, velocity distributions and liquid water content (LWC) in clouds. Current methodologies for determining drop size and LWC are time-consuming and/or lack accuracy, reliability, and versatility. In addition, they do not provide the drop velocity information or the high spatial and temporal resolution of the Phase Doppler Particle Analyzer (PDPA). In this preliminary study, the standard PDPA instrument was evaluated to determine its ability to measure LWC, number density, and drop size and drop velocity distributions. Based upon comparisons with other methods, the PDPA results showed good agreement. In addition, a prototype compact fiber optic probe was designed, fabricated and evaluated. The method showed exceptional promise as a field portable probe.

MP 3283

KINEMATIC MODEL OF RIVER ICE MOTION DURING DYNAMIC BREAKUP.

Ferrick, M.G., Weyrick, P.B., Nelson, D.F., *Nordic hydrology*, 1993, Vol.24, p.111-134, Presented at Northern Research Basin Symposium, 9th, Whitehorse, Yukon Territories, Canada, Aug. 1992. 19 refs. 47-4907

RIVER ICE, RIVER FLOW, ICE JAMS, ICE BREAKUP, DYNAMIC PROPERTIES, ICE MECHANICS, VELOCITY MEASUREMENT, ICE WATER INTERFACE, ICE MODELS, MATHEMATICAL MODELS

In this paper, the dynamics of ice motion during river breakup is studied by formulating a kinematic model. Ice continuity equations are applied to relate the speeds of a breaking front, a convergence front, a stoppage front, and a release front with the ice discharge and volume per unit surface area (unit volume) on either side of each front. Ice velocity was measured over time during a dynamic breakup at a pair of sites bounding a reach of the Connecticut River. The ice and front motion over time for this reach were simulated using the kinematic model, with the assumptions that accumulation thickness and porosity are uniform, and that changes in the ice conditions and motion occur only at a front. Contrary to the basic assumption of static jam formation, it is found that the accumulation developed while the ice was moving, and that jam formation merely represents the arrest of the motion.

MP 3284

EXPERIMENTAL AND NUMERICAL ANALYSIS OF FLOATING ICE BEAM IMPACT FORCES AGAINST A SLOPED STRUCTURE.

Coutermarsh, B.A., Hanover, NH, Dartmouth College, 1993, 51p., M.S. thesis. 10 refs. 47-5244

ICE LOADS, ICE SOLID INTERFACE, ICE FRICTION, ICE PRESSURE, PONTOON BRIDGES, MATHEMATICAL MODELS

Experiments were performed to determine the response of a floating ice beam to a vertically applied force. The data were used to calibrate a numerical finite element model of the floating ice. The ice was characterized as a linear elastic material in the numerical analysis, and the calibration data were used to assess this assumption as well as to develop a fluid influence coefficient matrix, to simulate the dynamic influence of the fluid beneath the ice beam. Finally, a scale model study was performed to determine actual impact forces generated by a floating ice beam against a 45 deg sloped structure. The numerical model developed was then compared to the actual data. The numerical model does well in predicting impact forces for all the beams at low velocity, and the force from the thicker ice beams at all velocities. Both the numerical and experimental forces show the same trends and appear to level off to approach a constant value with increasing beam length. The discrepancies between numerical predictions and experimental results are thought to be caused by damage to the experimental ice beams which is not accounted for in the numerical model.

MP 3285

COMPARISON OF AXIAL DOUBLE-BALL AND UNIAXIAL UNCONFINED COMPRESSION TESTS ON FRESHWATER AND SEA ICE SAMPLES.

Kovacs, A., International Conference on Port and Ocean Engineering under Arctic Conditions, 12th, Hamburg, Aug. 17-20, 1993. Proceedings. POAC 93. Vol.1, Hamburg, Germany, Hamburg Ship Model Basin, 1993, p.72-84, 35 refs. 48-93

ICE COVER STRENGTH, ICE LOADS, ICE BREAKING, ICE PRESSURE, ICE SOLID INTERFACE, STRAIN TESTS Axial double-ball load tests were made on freshwater ice and first-year and multiyear sea ice. From this simple test method, the apparent unconfined compressive strength of the ice was determined. The strength results are compared with those obtained from the complex and costly uniaxial unconfined compression test made on similar ice at a strain rate of .001/s. The scatter in the test data and the average ice strength obtained from both test methods were similar. The findings indicate that the expedient axial double-ball load test is well suited for determining the unconfined compressive strength of ice, especially in the field where logistical constraints and the demanding sample preparation requirements needed for unconfined compression test samples cannot be met.

MP 3286

GREENLAND ICE CORE "SIGNAL" CHARACTERISTICS: AN EXPANDED VIEW OF CLIMATIC CHANGE.

Mayewski, P.A., et al, *Journal of geophysical research*, July 20, 1993, 98(D7), p.12,839-12,847, 42 refs. 48-192

ICE SHEETS, ICE CORES, ICE DATING, CHEMICAL COMPOSITION, ION DENSITY (CONCENTRATION), CLIMATIC CHANGES, PERIODIC VARIATIONS, ATMOSPHERIC COMPOSITION, STATISTICAL ANALYSIS, GREENLAND

MP 3287

ENVIRONMENTAL ASPECTS OF RIVER ICE.

Prowse, T.D., ed, Gridley, N.C., ed, Calkins, D.J., Gatto, L.W., Saskatoon, Saskatchewan, National Hydrology Research Institute, 1993, 155p., Refs. p.127-155. 48-215

RIVER ICE, ICE WATER INTERFACE, ICE COVER EFFECT, ICE EROSION, RIVER FLOW, WATER CHEMISTRY, CRYOBIOLOGY, ENVIRONMENTAL IMPACT

MP 3288

RAIN-INDUCED WATER PERCOLATION IN SNOW AS DETECTED USING HEAT FLUX TRANSDUCERS.

Sturm, M.A., Holmgren, J., *Water resources research*, July 1993, 29(7), p.2323-2334, 27 refs. 48-284

SNOW HYDROLOGY, SNOW COVER STABILITY, RAIN, SEEPAGE, WATER FLOW, DETECTION, ICE WATER INTERFACE, TEMPERATURE MEASUREMENT, THERMISTORS, SUBSURFACE DRAINAGE, SNOW HEAT FLUX, RUNOFF FORECASTING

Large (15 x 15 cm) heat flux transducers (HFTs) were installed at the snow/ground interface at three locations in Alaska where rain on snow is common. During three winters, heat flux signals indicative of water percolating to the base of the snow were detected at two or more sites. All signals were coincident with rain-on-snow events, though not all rain-on-snow events (there were a total of 27) were associated with distinctive heat flux signals. Signals were observed only when rainfall rates exceeded 1.5 cm/day, and the character of the signal differed if the snow/ground interface was at or lower than 0 C. Observed delays between the start of rain and the arrival of water at the base of the snow ranged between 2 and 40 hours. A geometric analysis was used to calculate the spacing of percolation fingers or columns necessary to produce the observed number of times that water percolated onto the HFTs. The number of times there were abrupt changes in the temperature of thermistors installed in the snow adjacent to the HFTs was used in a similar manner. Results from both analyses suggest percolation columns with a mean spacing of about 25 cm, which is consistent with observations of these features in snow trenches.

MP 3289

DEPENDENCE OF POST-STABLE FLUIDELASTIC BEHAVIOR ON THE DEGREES OF FREEDOM OF A TUBE BUNDLE.

Lever, J.H., Rzentkowski, G., *Journal of fluids and structures*, 1993, Vol.7, p.471-496, 29 refs. 48-294

PIPES (TUBES), DUCTS, FLUID FLOW, PIPE FLOW, UNSTEADY FLOW, HEAT TRANSFER, DAMPING

Several experimental studies of fluidelastic instability in tube bundles have revealed the existence of post-stable hysteresis behavior. The objective of the present study was to determine the dependence of this behavior on the number of degrees of freedom of the bundle. A dominant tube typically controls the fluidelastic instability and post-stable behavior of a fully flexible bundle. Furthermore, a single-degree-of-freedom system (a tube constrained to move transverse to the flow) can display similar post-stable behavior like that of the entire bundle. Thus, for the arrays investigated, the fluidelastic mechanism requires neither fluid coupling between tubes nor coupling between streamwise and transverse motion of a single tube to generate hysteresis. However, the exact details of the post-stable behavior (e.g., hysteresis effects, limit cycle amplitudes) depend quite strongly on array misalignment and the number of upstream tube rows. Amplitude-dependent damping measurements reported here suggest that finite limit cycles result from fluidelastic, not structural, nonlinearity. Also, transient excitation tests indicate that turbulence may be substantially more likely than previously thought to excite instability of an array operating just inside a hysteresis region. For broad hysteresis regions, such reductions in critical velocity are as significant to heat-exchange design as array pitch and pattern effects. The present work suggests that a nonlinear, single-degree-of-freedom model would be a good first step towards their prediction.

MP 3290

TECHNICAL ASSESSMENT OF MAGLEV SYSTEM CONCEPTS.

Lever, J.H., International Conference on Magnetically Levitated Systems and Linear Drives, 13th, May 19-21, 1993, Argonne National Laboratory, IL, 1993, p.283-289, 7 refs. 48-295

RAILROADS, MAGNETIC PROPERTIES, COST ANALYSIS

This paper presents an overview of the methods and results of the Government Maglev System Assessment. As part of the National Maglev Initiative, the author examined the technical characteristics of the NMI's four contracted system concepts, the French TGV high-speed train and the German TR07 maglev prototype. In general, the U.S. concepts offer a potential for higher performance at similar cost compared with TR07. All five maglev concepts offer a large performance advantage over TGV.

MP 3291

FIELD BIOREMEDIATION RATES IN A COLD REGION LANDFARM: SPATIAL VARIABILITY.

Reynolds, C.M., Hydrocarbon contaminated soils. Vol.3. Edited by E.J. Calabrese and P.T. Kostecki, Chelsea, MI, Lewis Publishers, 1993, p.487-499, 14 refs. Presented at the annual conference held at the University of Massachusetts at Amherst. 48-297

SOIL POLLUTION, WASTE TREATMENT, SOIL CHEMISTRY, SOIL MICROBIOLOGY, OIL SPILLS

MP 3292

TEMPERATURE VARIATIONS IN THE ACTIVE LAYER OF PERMAFROST.

Aziz, A., Lunardini, V.J., International Conference on Permafrost, 6th, Beijing, China, July 5-9, 1993. Proceedings, Vol.1, Guangzhou, China, South China University of Technology Press, 1993, p.17-22, 16

refs.

48-352
FROZEN GROUND TEMPERATURE, PERMAFROST THERMAL PROPERTIES, ACTIVE LAYER, THAW DEPTH, TEMPERATURE VARIATIONS, FORECASTING, MATHEMATICAL MODELS, PHASE TRANSFORMATIONS
In this paper, a finite element numerical model was used to predict the temperature of the active layer subjected to a sinusoidal surface temperature variation. The predictions of the purely conductive heat transfer model demonstrated such basic characteristics of the active layer bottom temperature as the zero curtain effect. A simple analytic model based on the assumption of a homogeneous system was devised to predict the temperature variations in the active layer. The analysis, which combines phase-change and non-phase-change time spans for one year, yields temperature predictions that are within 6% of the numerical model. The approach is potentially adaptable to a surface energy boundary condition that can be used to evaluate the effect of short-term atmospheric changes on permafrost.

MP 3293 MEASUREMENT OF THERMAL STRESSES IN ASPHALT CONCRETE MIXTURES.

Janoo, V.C., Walsh, M.R., Bayer, J., Jr., Tomita, H., International Conference on Permafrost, 6th, Beijing, China, July 5-9, 1993. Proceedings, Vol.1, Guangzhou, China, South China University of Technology Press, 1993, p.292-297, 15 refs.

48-403

BITUMINOUS CONCRETES, CONCRETE PAVEMENTS, THERMAL STRESSES, CRACKING (FRACTURING), TEST EQUIPMENT, TEMPERATURE CONTROL, COLD WEATHER TESTS, STRAIN TESTS, PERFORMANCE, DESIGN

As part of the development of guidance for the selection of asphalt concrete mixtures that will resist thermal cracking in cold regions, CREL developed a thermal stress test device for measuring thermal induced stresses in asphalt concrete (AC) beams in the laboratory. The test device attempts to simulate the thermal strain in the longitudinal direction of the *in situ* AC layer. The device is capable of subjecting the test specimen to temperature change rates that vary between 1 C and 30 C/hr. Test specimens in the device can be subjected to both monotonic and cyclic thermal loading. This paper describes the thermal stress test device. Typical results from the test are also presented.

MP 3294 PERMAFROST FORMATION TIME.

Lunardini, V.J., International Conference on Permafrost, 6th, Beijing, China, July 5-9, 1993. Proceedings, Vol.1, Guangzhou, China, South China University of Technology Press, 1993, p.420-425, 36 refs.

48-428

PERMAFROST THICKNESS, PERMAFROST ORIGIN, TIME FACTOR, SOIL FREEZING, GEOCRYOLOGY, PERMAFROST THERMAL PROPERTIES, PHASE TRANSFORMATIONS, PALEOCLIMATOLOGY, FREEZE THAW CYCLES, MATHEMATICAL MODELS

The age of permafrost is related to the time required for soil systems to freeze, since permafrost is at least as old as its formation time. Freeze/thaw cycles complicate the relation between freeze rate and age. In this paper, a pure conduction heat transfer with freeze/thaw model is used to predict the time needed to form a given thickness of permafrost. The formation time is a function of the long-term geothermal gradient, the ratios of the frozen-to-thawed thermal properties, and the temperature history of the upper surface of the permafrost. The simple theory leads to universal graphs that predict the formation time. Realistic soil property ratios and paleo-temperature scenarios then lead to estimates of the formation time of permafrost. The model indicates that deep permafrost requires formation times on the order of the complete Quaternary Period.

MP 3295 EFFECT OF SOIL THAW ON OFF-ROAD VEHICLE TRACTION.

Shoop, S.A., International Conference on Permafrost, 6th, Beijing, China, July 5-9, 1993. Proceedings, Vol.1, Guangzhou, China, South China University of Technology Press, 1993, p.559-563, 12 refs.

48-454

ALL TERRAIN VEHICLES, TRACTION, PERFORMANCE, GROUND THAWING, THAW DEPTH, THAW WEAKENING, SOIL STRENGTH, WATER CONTENT, MECHANICAL TESTS, SOIL MECHANICS

To determine the effects of thawing on vehicle mobility, an instrumented vehicle was used to measure traction on a variety of thawing conditions of a frost-susceptible silty sand. The tests were performed in a large soil test basin where temperature and moisture conditions were controlled. Thawing causes a layering of the soil that is most pronounced when the soil is very wet, and therefore the thawed layer is extremely weak. Traction decreases substantially when the water content of the thawed layer is above the liquid limit of the soil. Traction also decreases as the thaw depth increases until a critical depth is attained, beyond which no fur-

ther traction is lost. For dry and intermediate water contents, trafficking the soil increases the obtainable traction, but for wet soils, trafficking increases traction only if it creates a favorable rut geometry.

MP 3296

ESTIMATION AND MEASUREMENTS OF TRANSPORT PROPERTIES OF FROZEN SOILS.

Yen, Y.C., Nakano, Y., International Conference on Permafrost, 6th, Beijing, China, July 5-9, 1993. Proceedings, Vol.1, Guangzhou, China, South China University of Technology Press, 1993, p.750-754, 23 refs.

48-492

SOIL PHYSICS, FROZEN GROUND MECHANICS, FROZEN GROUND THERMODYNAMICS, THERMAL CONDUCTIVITY, MASS TRANSFER, SOIL WATER MIGRATION, UNFROZEN WATER CONTENT, ANALYSIS (MATHEMATICS)

This paper briefly describes the thermal properties, unfrozen water content and hydraulic conductivities of soils. Methods of evaluating these property functions, which are vital to the understanding of the simultaneous heat and mass transport mechanism in soils, are reviewed and compared with experimental data. Frozen and unfrozen soils, both saturated and unsaturated, are considered, and the results are presented either in theoretical or empirical expressions.

MP 3297

INTRODUCTION AND OVERVIEW OF A STUDY DEALING WITH THE ROLE OF SALT-AFFECTED SOILS IN PRIMARY SUCCESSION ON THE TANANA RIVER FLOODPLAIN, INTERIOR ALASKA.

Van Cleve, K., Viereck, L.A., Marion, G.M., *Canadian journal of forest research*, May 1993, 23(5), p.879-888, With French summary. 25 refs.

48-637

RIVER BASINS, FLOODPLAINS, TAIGA, SUBARCTIC LANDSCAPES, FOREST ECOSYSTEMS, SALINE SOILS, FOREST LAND, VEGETATION PATTERNS, PLANT ECOLOGY, FORESTRY, UNITED STATES—ALASKA—TANANA RIVER

This paper provides an overview of the environmental setting, rationale, and organization of a multidisciplinary research program designed to examine the role of salt-affected soils in primary succession on the Tanana River floodplain of interior Alaska.

MP 3298

SOIL CHEMICAL ENVIRONMENT ALONG A FOREST PRIMARY SUCCESSIONAL SEQUENCE ON THE TANANA RIVER FLOODPLAIN, INTERIOR ALASKA.

Marion, G.M., Van Cleve, K., Dyrness, C.T., Black, C.H., *Canadian journal of forest research*, May 1993, 23(5), p.914-922, With French summary. 36 refs.

48-640

SUBARCTIC LANDSCAPES, TAIGA, FLOODPLAINS, FOREST ECOSYSTEMS, FOREST SOILS, REVEGETATION, SOIL FORMATION, SOIL CHEMISTRY, SALINE SOILS, SOIL TESTS, UNITED STATES—ALASKA—TANANA RIVER

The objectives of this study were to describe the soil chemical properties using saturation pastes; compare soil saturation paste ion activity products (IAP) to solubility products for pure minerals; examine mechanisms controlling the soil chemical properties; and examine some consequences of the chemical properties on the soil as a medium for plant growth along a forest primary successional sequence on the Tanana River floodplain of interior Alaska.

MP 3299

CALCIUM CARBONATE PRECIPITATION-DISSOLUTION ALONG A FOREST PRIMARY SUCCESSIONAL SEQUENCE ON THE TANANA RIVER FLOODPLAIN, INTERIOR ALASKA.

Marion, G.M., Van Cleve, K., Dyrness, C.T., *Canadian journal of forest research*, May 1993, 23(5), p.923-927, With French summary. 24 refs.

48-641

SUBARCTIC LANDSCAPES, TAIGA, FLOODPLAINS, FOREST ECOSYSTEMS, FOREST SOILS, VEGETATION FACTORS, SOIL PROFILES, SALINE SOILS, SOIL CHEMISTRY, SOIL FORMATION, UNITED STATES—ALASKA—TANANA RIVER

The objectives of this study were to determine the origin of the CaCO₃ (geologic or pedogenic); quantify CaCO₃ precipitation-dissolution; and quantify net system acidification-alkalinization along a forest primary successional sequence (250 years) on the Tanana River floodplain of interior Alaska.

MP 3300

CONTROL OF SOIL DEVELOPMENT ON THE TANANA RIVER FLOODPLAIN, INTERIOR ALASKA.

Van Cleve, K., Dyrness, C.T., Marion, G.M., Erickson, R., *Canadian journal of forest research*, May 1993, 23(5), p.941-955, With French summary. 30 refs.

48-643

SUBARCTIC LANDSCAPES, TAIGA, FLOODPLAINS, FOREST ECOSYSTEMS, REVEGETATION, FOREST SOILS, SOIL FORMATION, SALINE SOILS, ORGANIC SOILS, SOIL CHEMISTRY, UNITED STATES—ALASKA—TANANA RIVER

Alluvial soils on the Tanana River floodplain near Fairbanks, AK, were examined for development of physical and chemical properties in relation to soil depth and across a 200-year vegetation development sequence. Development was mediated by ecosystem controls including successional time, vegetation, terrace height, soil physical and chemical properties, and microclimate. These controls interact and are conditioned by the state factors time, flora, topography, parent material, and climate, respectively.

MP 3301

REMEDIAL INVESTIGATION REPORT FOR COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, HANOVER, NEW HAMPSHIRE. FINAL REPORT.

Ecology and Environment, Inc., Arlington, VA, U.S. Army Toxic and Hazardous Materials Agency, Oct. 1992, Var. p., Contract No. DAAA15-90-D-0012, Refs. p.10/1-10/6.

48-318

SOIL POLLUTION, WATER POLLUTION, GROUND WATER, OIL SPILLS, ENVIRONMENTAL IMPACT, HYDROGEOCHEMISTRY, SOIL CHEMISTRY, SOIL ANALYSIS, WELLS

MP 3302

OBJECT-ORIENTED METHODS FOR HYDROLOGIC MODELING AND REMOTE SENSING.

McKim, H.L., LaPotin, P.J., Cassell, E.A., Bruzewicz, A.J., *U.S. Geological Survey. Water-resources investigations report*, 1993, No.93-4018, Federal Interagency Workshop on Hydrologic Modeling Demands for the 90's, Fort Collins, CO, June 6-9, 1993. Proceedings. Edited by J.S. Burton, p.3/9-3/17, 18 refs.

48-683

SNOWMELT, SNOW HYDROLOGY, RUNOFF FORECASTING, STREAM FLOW, SPACEBORNE PHOTOGRAPHY, DATA PROCESSING, COMPUTERIZED SIMULATION
Operational satellites provide reliable periodic coverage for all areas of the Earth. Data from these satellites are obtained in a digital format that provides enhanced flexibility for hydrologic modeling. Considerable advances in acquiring hydrologic data from airborne and *in situ* sensors also have been achieved. Additionally, data from non-traditional remote sensing sources such as weather radar (from which spatial and temporal rainfall rates may be estimated) are widely available. New data acquisition capabilities have been paralleled by equal advancements in digital array processing and geographic information systems, which allow for effective extraction of both temporal and spatial information. This paper examines the use of object-oriented programming techniques as a method to create dynamic hydrologic models, and explores the potential application of object models to receive real and near real-time data from remote sensing sources. In this context, the Streamflow Synthesis and Reservoir Regulation Model (SSARR) is used to illustrate the conversion of an established hydrologic model to the object oriented framework as a method to improve hydrologic forecasting.

MP 3303

SNOWMELT RUNOFF FORECASTING.

Pangburn, T., Nagle, J.A., Davis, R.E., *U.S. Geological Survey. Water-resources investigations report*, 1993, No.93-4018, Federal Interagency Workshop on Hydrologic Modeling Demands for the 90's, Fort Collins, CO, June 6-9, 1993. Proceedings. Edited by J.S. Burton, p.5/20-5/27, 32 refs.

48-685

SNOW SURVEYS, SNOWMELT, SNOW HYDROLOGY, RUNOFF FORECASTING, DATA PROCESSING, COMPUTERIZED SIMULATION

The history of operational snowmelt forecasting by the U.S. Army Corps of Engineers and recent developments in modeling tools are described. Since the early 1940s, the U.S. Army Corps of Engineers has been instrumental in developing methodologies for snowmelt forecasting. These methodologies have been applied in numerous simulation models, including SSARR, HEC-1F, and NWSRFS. Recently developed modeling tools include the application of object-oriented programming, the development of interfaces to Geographic Information Systems (GIS), and the use of remotely sensed snow cover information. These tools have

led to improved physically based models that characterize internal watershed processes, such as flow path and source area delineation, snowpack accumulation and distribution, and surface energy exchange.

MP 3304

CURRENT ISSUES IN RIVER ICE FORECASTING.

White, K.D., Zufelt, J.E., Daly, S.F., *U.S. Geological Survey. Water-resources investigations report*, 1993, No.93-4018, Federal Interagency Workshop on Hydrologic Modeling Demands for the 90's, Fort Collins, CO, June 6-9, 1993. Proceedings. Edited by J.S. Burton, p.5/74-5/80, 3 refs.

48-686

RIVER ICE, ICE FORECASTING, ICE FORMATION, ICE BREAKUP, ICE JAMS

Ice formation and breakup can affect the operation of hydraulic structures in a number of ways. Adverse impacts include blockage of water intake trash racks by frazil ice, increased transit time through locks due to ice accumulations in the lock chambers and on gates, freeze-up of dam gates, channel bed and bank erosion and flooding due to ice jams, and structural damage to hydraulic structures from ice impacts. The ability to forecast river and lake ice formation and breakup provides the opportunity to make operational decisions that could reduce or prevent some ice-related problems. Forecasting river ice formation or breakup involves understanding and predicting complicated thermal, meteorological, and hydrologic processes. Successful ice forecasting requires that all three processes be forecast accurately over the period in which the ice forecast is to be made. Limitations in any of these three forecasts will limit the usefulness of the ice forecast. River ice models are therefore a fundamental test of the knowledge of river ice processes, the ability to numerically model these processes, the ability to collect and manage a wide variety of field data, and the organizational ability to integrate the data and operate the models to produce reasonable and timely forecasts. An overview of current issues in river ice forecasting is presented.

MP 3305

REVIEW OF ENVIRONMENTAL RESEARCH SPECIFIC TO SMART WEAPONS OPERABILITY ENHANCEMENT FOR THE BATTLEFIELD ENVIRONMENT.

Welsh, J.P., Hardaway, M., West, W., Army science: the new frontiers: military and civilian applications, Saratoga, WY, Borg Biomedical Books, 1993, p.679-686.

48-690

TERRAIN IDENTIFICATION, ENVIRONMENT SIMULATION, IMAGE PROCESSING, DATA PROCESSING, MILITARY ENGINEERING, MILITARY RESEARCH, DETECTION

The Smart Weapons Operability Enhancement (SWOE) Program is developing an integrated physics-based scene generation process to consider complex target and background environment interactions for varied battlefield conditions. The product of this program is an integrated process that will enhance the performance of future smart weapons systems for a global variety of battlefield environments. The "weapon system environment" is number 11 on the DoD critical technologies list. "Synthetic Environments" is also a principal thrust area for DoD Science and Technology. Components of the environment have been quantitatively shown to impact the performance of electromagnetic and electro-optical weapon systems. The SWOE Program has provided a focus for coordinated and cooperative investigations of critical environment factors and processes that significantly impact weapon performance.

MP 3306

WINTER TRACTION TESTING USING THREE DIFFERENT INSTRUMENTED VEHICLES.

Shoop, S.A., Young, B., Alger, R., Davis, J., International Conference of the ISTVS, 11th, Lake Tahoe, NV, Sep. 27-30, 1993. Proceedings. Vol.1, Hanover, NH, International Society for Terrain-Vehicle Systems, 1993, p.169-180, 10 refs.

48-757

ROAD ICING, RUBBER ICE FRICTION, RUBBER SNOW FRICTION, TIRES, TRACTION, COLD WEATHER PERFORMANCE, COLD WEATHER TESTS

Traction on winter surfaces was measured using three test vehicles, each designed to measure traction for a different purpose: vehicle mobility research (CRREL instrumented vehicle), commercial tire testing (Uniroyal-Goodrich traction tester) and airport runway safety (Saab friction tester). The traction measured with each method is comparable, but there are systematic differences due to the effects of the surface materials and test and analysis techniques. This comparison serves as the basis for collaboration between the various traction testing communities and illustrates the need for well documented, standard test procedures and data analyses for traction testing and evaluation.

MP 3307

ALBE TACTICAL DECISION AID (TDA) USER'S GUIDE (VERSION 2.1). AIRLAND BAT-

TLEFIELD ENVIRONMENT TECHNOLOGY DEMONSTRATION PROGRAM. FINAL REPORT.

U.S. Army Corps of Engineers, *U.S. Army Waterways Experiment Station. Geotechnical Laboratory. Miscellaneous paper*, Sep. 1993, GL-93-20, Var. p., 10 refs. The U.S. Army Cold Regions Research and Engineering Laboratory is one of the contributing organizations.

48-786

ENVIRONMENT SIMULATION, COMPUTERIZED SIMULATION, COMPUTER PROGRAMS, DATA PROCESSING, MILITARY OPERATION, TERRAIN IDENTIFICATION, WEATHER FORECASTING, AIRCRAFT ICING, ICE FORECASTING, FLOOD FORECASTING

MP 3308

DETERMINATION OF TWO CHLORINATED VOLATILE ORGANIC COMPOUNDS IN SOILS BY HEADSPACE GAS CHROMATOGRAPHY AND PURGE-AND-TRAP GAS CHROMATOGRAPHY MASS SPECTROMETRY.

Hewitt, A.D., Miyares, P.H., Sletten, R.S., *Hydrocarbon contaminated soils*, Boca Raton, FL, CRC Press, 1993, p.135-145, 13 refs.

48-798

SOIL POLLUTION, SOIL CHEMISTRY, SOIL ANALYSIS, WASTE DISPOSAL, CHEMICAL ANALYSIS, SPECTROSCOPY, DETECTION

MP 3309

USE AND CALIBRATION OF ROSEMOUNT ICE DETECTORS FOR METEOROLOGICAL RESEARCH.

Claffey, K.J., Jones, K.F., Ryerson, C.C., International Workshop on the Atmospheric Icing of Structures, 6th, Budapest, Sep. 20-23, 1993. Proceedings. IWAIS '93, Budapest, 1993, p.105-108, 6 refs.

48-825

AIRCRAFT ICING, ICE DETECTION, ICE ACCRETION, ICE LOADS, CLOUD DROPLETS, UNFROZEN WATER CONTENT, WARNING SYSTEMS, THICKNESS GAGES, MEASURING INSTRUMENTS

Vibrating probe ice detectors made by the Rosemount Engineering Co. are used by many researchers for measuring atmospheric icing rates and cloud liquid water contents. The vibration frequency of the probe decreases as ice accretes on it until the probe is deiced at a factory-set frequency. Rosemount ice detectors are favored because they are readily available, easy to install and simple to operate. They are designed as warning systems for incipient aircraft and antenna icing, and not as precisely calibrated scientific instruments. Calibration cannot be user-adjusted, but it can be measured and must be periodically checked if the ice detector is to be used in scientific studies. The authors briefly describe three models of Rosemount ice detectors that CRREL has used. Methods for collecting and processing the data from these detectors are described and evaluated. Procedures developed at CRREL for calibrating Rosemount detectors against a rotating multicylinder in natural icing conditions are presented. Results of calibrations of two model 872B12 Rosemount ice detectors with the rotating multicylinder are presented and discussed. Use of the ice detector record to calculate cloud liquid water content is shown.

MP 3310

EFFECT OF HORIZONTAL AND TORSIONAL COUPLING ON VERTICAL GALLOPING.

Jones, K.F., International Workshop on the Atmospheric Icing of Structures, 6th, Budapest, Sep. 20-23, 1993. Proceedings. IWAIS '93, Budapest, 1993, p.143-148, 16 refs.

48-832

POWER LINE ICING, ICE ACCRETION, ICE LOADS, WIND PRESSURE, DAMPING, VIBRATION, MATHEMATICAL MODELS

Both horizontal and torsional conductor motion are commonly observed with high-amplitude, low-frequency galloping associated with ice accretions on power lines. In this paper the influence of these subsidiary motions on predominantly vertical galloping is examined. Linearized coupled lumped-mass equations of motion are presented for the horizontal-vertical-torsional system. Because of the intrinsic coupling between vertical and horizontal conductor motion through the lift and drag forces, an initial horizontal motion of the conductor can develop into vertical galloping. This horizontal coupling modifies Den Hartog's criterion for vertical galloping. The solution to the horizontal-vertical pair of equations gives the modified criterion, which depends on the lift and drag coefficients and their slopes. A non-zero moment coefficient couples torsion to the vertical-horizontal system. As this three-degree-of-freedom system cannot be solved analytically, the analytic solution to the vertical-torsional pair of equations is then determined. The vertical, horizontal-vertical and vertical-torsional analytic solutions are compared to a numerical solution for the full 3-D system using the aerodynamic properties of two accreted ice cross sections to illustrate their

similarities and differences. It appears that the horizontal-vertical galloping criterion represents the criterion for the full 3-D system better than the vertical-torsional criterion does.

MP 3311

ICE DETECTOR PREDICTION OF TRANSMISSION LINE ICE LOADS IN NORTHWESTERN ICELAND.

Ryerson, C.C., Eliasson, A.J., International Workshop on the Atmospheric Icing of Structures, 6th, Budapest, Sep. 20-23, 1993. Proceedings. IWAIS '93, Budapest, 1993, p.189-194, 14 refs.

48-840

POWER LINE ICING, ICE ACCRETION, ICE LOADS, ICE FORECASTING, ICE DETECTION, METEOROLOGICAL INSTRUMENTS, MONITORS, ICELAND

Iceland has a vigorous test span ice monitoring program, with ice loads measured continuously at some locations with automatic tension recorders. These recorders are in operation on a 66-kV line at Hestakleif in the Westfjords region, where ice load and air temperature data acquisition started in Jan. 1992. Independently, CRREL has monitored icing at Bolafjall, 10 km north of Hestakleif, since Nov. 1991 with a Rosemount ice detector, along with temperature and wind. Since the sites are similar, the purpose of this study is to determine if the Rosemount ice detector, when used to compute fog liquid water content, can reliably predict ice load on a transmission line. Increases in ice load on the tension recorder visually appear to correspond well to deicing cycles recorded by the ice detector. However, total ice loads on the test line were not well predicted when modeled using ice detector-computed liquid water content, because wind and liquid water were not measured at the line, fog droplet diameters were not measured and ice unloading was not modeled. Model simulations of ice accretion, though often unreliable, were most accurate when the line completely cleared of ice between icing events, and when wind measurements were made from a location near the line. The study demonstrates that an ice detector located near a test line can provide useful indications of the presence and magnitude of supercooled liquid water.

MP 3312

ICING-RELATED TOWER FAILURES IN THE U.S.A. AND FENNO-SCANDINAVIA.

Sundin, E., Mulherin, N.D., International Workshop on the Atmospheric Icing of Structures, 6th, Budapest, Sep. 20-23, 1993. Proceedings. IWAIS '93, Budapest, 1993, p.273-278, 6 refs.

48-854

ICE ACCRETION, ICE LOADS, ICE STORMS, SNOW-STORMS, WIND PRESSURE, TOWERS, ACCIDENTS Numerous radio and television broadcasting towers have collapsed due to atmospheric icing. These failures are reportedly the result of various mechanisms (e.g. additional dead weight or wind loading, non-symmetrical ice shedding, tower or guy wire damage due to icefall, and galloping). Several icing related tower failures in the United States and Fenno-Scandinavia are examined here. The towers ranged in height from 75 to 610 m. Each event is summarized in terms of the structural and site characteristics, the concurrent meso-scale meteorological conditions, and the resulting damage costs. Common phenomena within these events that will provide insight into preventing future episodes of this type are identified.

MP 3313

SUPERSTRUCTURE SPRAY AND ICE ACCRETION ON A LARGE U.S. COAST GUARD CUTTER.

Ryerson, C.C., International Workshop on the Atmospheric Icing of Structures, 6th, Budapest, Sep. 20-23, 1993. Proceedings. IWAIS '93, Budapest, 1993, p.280-285, 25 refs.

48-855

SHIP ICING, ICE ACCRETION, ICE LOADS, SEA SPRAY, SUPERSTRUCTURES

Superstructure spray flux and ice accretion were measured on a 115 m Coast Guard cutter in the North Pacific Ocean and the Bering Sea during Feb. and Mar. 1990 to support the requirements of icing modelers. This was the first such measurement cruise on a large ship; all previous measurements have been on trawlers and patrol boats. Spray event durations averaged 2.73 s, somewhat longer than events measured on a 35 m Soviet trawler. The drop number concentration of most spray clouds was high, ranging from 200,000 to 300,000 drops/cu m. Spray cloud drop sizes ranged from 14 to 7700 microns, with a geometric median of 234 microns. Spray cloud liquid water contents had a very large range, with a mean of 64.1 g/cu m. Ice accretion rates were light but sufficient for observing greater ice thicknesses on decks than on bulkheads. The ice accretion process was also found to be extremely dynamic, alternately accreting and ablating several times before reaching maximum thickness.

MP 3314

OSMOTIC MODEL OF ICE SEGREGATION.

Horiguchi, K., Nakano, Y., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1993, SR 93-22, International Symposium on

Thermal Engineering and Science for Cold Regions, 4th, Hanover, NH, Sep. 28-Oct. 1, 1993. Proceedings. Edited by V.J. Lunardini and S.L. Bowen, p.17-23, 31 refs.

48-859

SOIL FREEZING, FREEZING FRONT, FROZEN GROUND THERMODYNAMICS, ICE LENSES, GROUND ICE, FROST HEAVE, SOIL WATER MIGRATION, SOIL PRESSURE, MATHEMATICAL MODELS

The growth of a segregated ice layer in freezing soils is a nonequilibrium phenomenon with the simultaneous transport of water and heat. The phenomenon has attracted the attention of many researchers in the past, but there is not yet a consensus on the mechanism of ice segregation. A brief overview on the subject is followed by the presentation of recent research results on the osmotic model of ice segregation. Using the model, the authors discuss the relationships among water flux, freezing temperature, supercooling of the unfrozen film water and heaving pressure.

MP 3315

STABILITY OF THICK ICE FORMATION IN PIPES.

Albert, M.R., Olfe, D.B., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1993, SR 93-22, International Symposium on Thermal Engineering and Science for Cold Regions, 4th, Hanover, NH, Sep. 28-Oct. 1, 1993. Proceedings. Edited by V.J. Lunardini and S.L. Bowen, p.81-86, 11 refs.

48-866

ICE FORMATION, ICE WATER INTERFACE, ICE SOLID INTERFACE, ICE HEAT FLUX, PIPELINE FREEZING, PIPE FLOW, WATER FLOW, MATHEMATICAL MODELS
Many researchers have observed that, under some flow and temperature conditions, the ice in rivers, channels, and pipes exhibits at the ice/water interface an irregular or wavy profile due to the thermal interaction between the moving interface and the flow over it. This analysis investigates the thermal stability of a small-amplitude sinusoidal perturbation of the ice/water interface in cylindrical geometries such as pipes. The focus is on effects due to conduction through the ice. For planar geometries such as river ice or flow between parallel plates, the onset of waviness must come from thermal effects in the flowing fluid. A novel result of the work presented here is that, for thick ice in pipes, the heat conduction through the ice itself can be a destabilizing effect that promotes waviness growth, even in a stagnant fluid. This effect is not present in planar situations such as ice sheets. The heat flux from the ice is most destabilizing for ice that is thick relative to the effective pipe radius, and for perturbation wavelengths that are long relative to the ice thickness.

MP 3316

DESIGN OF AN ANTARCTIC WATER WELL.

Lunardini, V.J., Rand, J.H., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1993, SR 93-22, International Symposium on Thermal Engineering and Science for Cold Regions, 4th, Hanover, NH, Sep. 28-Oct. 1, 1993. Proceedings. Edited by V.J. Lunardini and S.L. Bowen, p.143-152, 22 refs.

48-873

WELLS, WATER SUPPLY, ICE (WATER STORAGE), ARTIFICIAL MELTING, MELT WATER, ICE HEAT FLUX, COLD WEATHER CONSTRUCTION, MATHEMATICAL MODELS, ANTARCTICA—AMUNDSEN-SCOTT STATION
Potable water for Amundsen-Scott Station is obtained by melting surface snow and storing the water. This method has the following drawbacks: fuel costs are very high, the surface can be contaminated, and gathering snow can be dangerous during the polar night. Melting snow or ice at depth and forming *in situ* water reservoir can overcome these handicaps. A method to obtain a thermal design for the Amundsen-Scott Station is described. A design for meeting the water needs of the station for 10 years while keeping the reservoir depth to less than 500 ft is discussed. (Auth.)

MP 3317

EFFECT OF TEMPERATURE CYCLES ON PERMAFROST FORMATION TIME.

Lunardini, V.J., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1993, SR 93-22, International Symposium on Thermal Engineering and Science for Cold Regions, 4th, Hanover, NH, Sep. 28-Oct. 1, 1993. Proceedings. Edited by V.J. Lunardini and S.L. Bowen, p.188-196, 26 refs.

48-878

PERMAFROST THERMAL PROPERTIES, PERMAFROST HEAT TRANSFER, PERMAFROST ORIGIN, PERMAFROST THICKNESS, PALEOCLIMATOLOGY, THERMAL REGIME, MATHEMATICAL MODELS

The time required for a given thickness of permafrost to form is becoming of greater interest due to the threat of global warming. The formation time for a heterogeneous system has been estimated using simple conduction theory. The predicted times can be on the order of geologic time scales because of the very large sensi-

ble heat inherent in a soil with a geothermal gradient. It is shown that when the effect of cyclic warming and cooling is also considered, the predicted formation times are significantly reduced. However, cyclic thermal modulation will only be effective for relatively shallow permafrost, since the warming times are much shorter than the cooling times.

MP 3318

OPEN-TOP DEVICES FOR MANIPULATING FIELD TEMPERATURES IN TUNDRA ECOSYSTEMS.

Marion, G.M., Henry, G.H.R., Molgaard, P., Oechel, W.C., Jones, M.H., Vourlitis, G.L., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1993, SR 93-22, International Symposium on Thermal Engineering and Science for Cold Regions, 4th, Hanover, NH, Sep. 28-Oct. 1, 1993. Proceedings. Edited by V.J. Lunardini and S.L. Bowen, p.205-210, 9 refs.

48-880

TUNDRA, PLANT ECOLOGY, PHENOLOGY, GLOBAL WARMING, TEMPERATURE CONTROL

This paper documents the performance of three open-top devices (right-angle corners, hexagonal chambers, and cone chambers) for manipulating temperature around tundra plant species in the Arctic. During the 1992 summer at four arctic sites, mean daily temperatures were increased by 1.4-1.8°C with these open-top designs. Because these devices act primarily as solar traps, the preferred orientation of the asymmetrical corners is an opening to the south that maximizes direct solar radiation to the plants and soil. Relative to controls, these devices lead to daytime air warming and nighttime air cooling, but both daytime and nighttime soil warming. Spatial variability in temperature within and between chambers is high, which necessitates a large sample size for statistical analyses.

MP 3319

THAWING OF SEASONAL FROZEN GROUND AT SNOWSHOE LAKE, ALASKA.

Bilello, M.A., Lunardini, V.J., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1993, SR 93-22, International Symposium on Thermal Engineering and Science for Cold Regions, 4th, Hanover, NH, Sep. 28-Oct. 1, 1993. Proceedings. Edited by V.J. Lunardini and S.L. Bowen, p.222-225, 3 refs.

48-882

GROUND THAWING, THAW DEPTH, SEASONAL FREEZE THAW, ACTIVE LAYER, SOIL AIR INTERFACE, UNITED STATES—ALASKA—SNOWSHOE LAKE
Recent concerns about global warming have made long time data sets in arctic regions of particular importance. Measurements of thaw depths taken over a number of years at a single site in Alaska are relatively rare. These data can be useful for comparison to thawing that has occurred in recent years. The thaw or freeze at a site is an integration of the yearly surface energy exchange and may yield information on climate changes over long periods. Thaw depths were obtained at several sites for eleven stations in Alaska during the time period of 1967 to 1978. The data for three sites at one station (Snowshoe Lake) are presented and the yearly variability is shown to be quite large.

MP 3320

EFFECTS OF FOUNDATION INSULATION AND THERMOSYPHONS ON PERMAFROST.

Haynes, F.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1993, SR 93-22, International Symposium on Thermal Engineering and Science for Cold Regions, 4th, Hanover, NH, Sep. 28-Oct. 1, 1993. Proceedings. Edited by V.J. Lunardini and S.L. Bowen, p.226-230, 11 refs.

48-883

PERMAFROST PRESERVATION, PERMAFROST BENEATH STRUCTURES, PERMAFROST HEAT TRANSFER, THERMAL INSULATION, SOIL STABILIZATION, ARTIFICIAL FREEZING, FOUNDATIONS, HEAT PIPES, COST ANALYSIS

Rigid board insulation is commonly used in foundations of buildings located in ice-rich permafrost regions. The effect of insulation thickness is investigated with a finite element analysis. Thermosyphons, placed between the insulation and the underlying permafrost at the power plant building at Gakona, AK, are also included in the analysis. The effect of insulation placed on the perimeter of a building also is analyzed.

MP 3321

GROWTH CONDITION OF A SEGREGATED ICE LAYER AND THE SEGREGATION POTENTIAL.

Nakano, Y., Takeda, K., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1993, SR 93-22, International Symposium on Thermal Engineering and Science for Cold Regions, 4th, Hanover, NH, Sep. 28-Oct. 1, 1993. Proceed-

ings. Edited by V.J. Lunardini and S.L. Bowen, p.250-255, 20 refs.

48-886

SOIL FREEZING, FREEZING FRONT, FROZEN GROUND THERMODYNAMICS, ICE LENSES, FROST FORECASTING, SOIL WATER MIGRATION, SOIL PRESSURE, MATHEMATICAL MODELS

It has recently been shown that the growth condition of a segregated ice layer in freezing soil is accurately described by a model of a frozen fringe in which the gradients of temperature and unfrozen water pressure are two independent driving forces of water. The segregation potential (SP) theory of soil freezing was examined by using this model and empirical findings. The SP theory is an approximate but useful tool for engineering problems. However, the accuracy of the theory in predicting the process of growing a final ice layer can be significantly improved if the neglected term of the pressure gradient is restored in the equation of water flow.

MP 3322

NATURAL CONVECTION HEAT TRANSFER IN WATER NEAR ITS DENSITY MAXIMUM.

Yen, Y.C., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1993, SR 93-22, International Symposium on Thermal Engineering and Science for Cold Regions, 4th, Hanover, NH, Sep. 28-Oct. 1, 1993. Proceedings. Edited by V.J. Lunardini and S.L. Bowen, p.329-345, 30 refs.

48-895

ICE WATER INTERFACE, ICE MELTING, ICE THERMAL PROPERTIES, ICE HEAT FLUX, HEAT TRANSFER, CONVECTION, DENSITY (MASS/VOLUME), MATHEMATICAL MODELS

This paper deals exclusively with systems exhibiting the density anomaly of water. The effect of this density inversion on flow patterns, and especially temperature distributions and subsequently the heat transfer characteristics, has been summarized. A condition of minimum heat transfer can be generally expressed in terms of a density distribution parameter (or inversion parameter) for most of the geometrical configurations covered in this work.

MP 3323

COMPARISON OF SITE CHARACTERIZATION FOR TRICHLOROETHYLENE BY HEADSPACE GAS CHROMATOGRAPHY AND PURGE-AND-TRAP GAS CHROMATOGRAPHY.

Hewitt, A.D., *U.S. Environmental Protection Agency International Symposium and Specialty Conference on Field Screening Methods for Hazardous Wastes and Toxic Chemicals*, 3rd, Las Vegas, Feb. 1993. Proceedings, Pittsburgh, Air and Waste Management Association, 1993, p.195-202, 20 refs.

48-1092

SOIL POLLUTION, SOIL CHEMISTRY, SOIL ANALYSIS, GROUND WATER, WATER POLLUTION, WASTE DISPOSAL, CHEMICAL ANALYSIS, SPECTROSCOPY, DETECTION

During a recent site investigation to define the extent of trichloroethylene (TCE) contamination in the vadose zone and underlying groundwater, samples were taken for analysis using headspace gas chromatography (HS/GC) and purge-and-trap gas chromatography mass spectrometry (PT/GC/MS). Soil subsamples were collected from the same split spoon using both the common practice of filling transfer bottles and by obtaining soil plugs with a coring device that transfers small (2-5 g) test samples with limited disruption and exposure. Aqueous samples were collected by using dedicated Teflon bailers to completely fill 40 mL vials. Overall, the TCE concentrations in these matrices were independent of analysis method, once the error inherent in the common practice of transferring soil to and from a collection vessel was recognized. These results verify the usefulness of using on-site HS/GC analysis for quantitative assessment of volatile organic compounds in soil and aqueous matrices.

MP 3324

ENVIRONMENTALLY INDUCED VARIATION IN THE DETECTABILITY OF FENCE-MOUNTED INTRUSION DETECTION SYSTEMS.

Peck, L., 34th annual meeting, Scottsdale, AZ, July 18-21, 1993. Proceedings, Northbrook, IL, Institute of Nuclear Materials Management, 1993, p.122-130, 3 refs.

48-1093

WARNING SYSTEMS, DETECTION, SENSORS

Seasonal differences in the normal stiffness of the chain-link fence panels at CRREL's intrusion detection system (IDS) research facility have been determined using a CRREL-developed fence characterization kit. These results quantify changes in the fence panels' response to loading that result from thermal contraction or expansion of the fence elements. To assess seasonal differences in IDS response to fence motion, the proximity-to-alarm status of three fence-mounted IDSs has been continually monitored. Weather-related diurnal patterns in the likelihood of occurrence of nuisance alarms have been determined. This infor-

mation allows security personnel to anticipate when the detectability of fence-mounted IDSs will vary because of wind-induced motion of chain-link fences and temperature-dependent differences in fence stiffness.

MP 3325

IMPACT OF DIFFERENT BACKGROUNDS ON THERMAL INFRARED IDS PERFORMANCE.

Lacombe, J., 34th annual meeting, Scottsdale, AZ, July 18-21, 1993. Proceedings, Northbrook, IL, Institute of Nuclear Materials Management., 1993, p.1042-1049, 14 refs.

48-1094

WARNING SYSTEMS, DETECTION, SENSORS, INFRARED RECONNAISSANCE, MATHEMATICAL MODELS

The performance of a passive thermal infrared IDS (intrusion detection system) employed in an exterior security application can be significantly impacted by the synergistic effects of the local background and weather. These effects can lead to nuisance alarms resulting from radiance fluctuations in the background. They can also lead to missed intrusion detections due to inadequate thermal contrasts between the intruder and background. It is important to identify and to quantify the environmental scenarios which pose such risks to an infrared IDS. This paper describes, through the use of a model presented at last year's INMM annual meeting and a recently developed intruder thermal model, how several different background types affect the ability of a specific passive infrared IDS to detect intruders. The issues discussed and problems identified apply to passive infrared IDSs in general, and not just to the specific system examined.

MP 3326

MODELING SOLVENT EXTRACTION USING THE SOLVATOCHROMIC PARAMETERS ALPHA, BETA AND PI.

Leggett, D.C., *Analytical chemistry*, Oct. 15, 1993, 65(20), p.2907-2909, 13 refs.

48-1098

SOLUTIONS, HYDRATES, ADMIXTURES, DISPERSIONS, WATER CHEMISTRY, CHEMICAL ANALYSIS, SOLUBILITY, MATHEMATICAL MODELS, STATISTICAL ANALYSIS

A linear solvation energy relationship employing only three solvatochromic parameters was shown to be adequate for describing solvent/water distribution processes for single solutes. Examples of its application are given for dimethyl methylphosphonate, phenol, aniline, and acetylacetone. This kind of model could, in principle, be used by analytical chemists and chemical engineers to design and optimize solvent extraction processes.

MP 3327

LABORATORY TESTING TO EVALUATE CHANGES IN HYDRAULIC CONDUCTIVITY CAUSED BY FREEZE-THAW: STATE-OF-THE-ART.

Othman, M.A., Benson, C.H., Chamberlain, E.J., Zimmie, T.F., Effect of freeze-thaw on the structure and hydraulic conductivity of compacted clays, Madison, University of Wisconsin, 1992, p.6-44, 27 refs. Paper included in Ph.D. thesis by M.A. Othman.

48-1110

CLAY SOILS, SOIL FREEZING, FREEZE THAW TESTS, FROST ACTION, FROST RESISTANCE, SOIL COMPACTION, SOIL WATER MIGRATION, PERMEABILITY, LINDINGS

Several laboratory studies have shown that the hydraulic conductivity of compacted clays may increase up to three orders of magnitude when subjected to freeze-thaw. In this paper, methods to freeze and thaw specimens of compacted clay are reviewed and compared. Methods to measure the hydraulic conductivity of the specimens are also reviewed. A review of testing conditions present during freeze-thaw and their effect on hydraulic conductivity is also included. Testing conditions that are addressed include availability of an external supply of water (closed vs. open system), dimensionality of freezing (1-D vs. 3-D), rate of freezing, ultimate temperature, number of freeze-thaw cycles, and state of stress. The rate of freezing, number of freeze-thaw cycles, and state of stress appear to have the largest effect on hydraulic conductivity. The effect of sampling disturbance on the hydraulic conductivity of compacted clay subjected to freeze-thaw is also presented. It is shown that specimens removed in Shelby tubes may be disturbed during sampling and extrusion. As a result, the effects of freeze-thaw can be masked. Collecting undisturbed block specimens is suggested as an alternative procedure, and a method to collect these specimens is presented.

MP 3328

DATING ICE CORES.

Hammer, C.U., Meese, D.A., *Nature*, June 24, 1993, 363(6431), p.666, 3 refs.

48-1122

ICE CORES, ICE DATING, GREENLAND

MP 3329

INTERNATIONAL CLASSIFICATION OF SEASONAL SNOW ON THE GROUND. [Classificazione internazionale della neve stagionale presente al suolo]

Colbeck, S.C., et al, *Neve e valanghe*, July 1993, No.19, p.i-xx, For English original see 45-1174.

48-1135

SNOW SURVEYS, SNOW COVER STRUCTURE, SNOW MORPHOLOGY, SNOW CRYSTAL STRUCTURE, TERMINOLOGY

MP 3330

SNOWMELT RUNOFF AND TOTAL SOLIDS PRODUCTION IN A DISCONTINUOUS PERMAFROST BASIN.

Chacho, E.F., Jr., *Nordic hydrology*, 1993, 24(2-3), p.65-78, Presented at the 9th Northern Research Basins Symposium, Whitehorse, Yukon, Canada, Aug. 11-15, 1992. 6 refs.

48-1151

WATERSHEDS, SUBARCTIC LANDSCAPES, DISCONTINUOUS PERMAFROST, SNOW HYDROLOGY, SNOWMELT, STREAM FLOW, SUSPENDED SEDIMENTS, RUNOFF, HYDROGRAPHY, SEASONAL VARIATIONS, UNITED STATES—ALASKA

Snowmelt runoff and total suspended solids were measured for two years on Glenn Creek, a small, second-order subarctic stream located near Fairbanks, AK, within the Yukon-Tanana Uplands physiographic province. The stream drains a 2.25 sq km research watershed of which 70% is underlain by permafrost. The two years of study represent contrasting snowmelt hydrographs due to differences in the snowpacks. In 1985, the snowpack was 180% of the long-term average, while in 1988 it was only 56% of the average. During both years, 60% of the total snowmelt-season water yield had passed before a significant rate of solids yield was observed. Also in both years the peak in total suspended solids concentration lagged the stream discharge peak by three days. Diurnal fluctuations in discharge and total suspended solids concentrations are well-defined, including a peculiar occurrence of double diurnal peaks in the discharge hydrograph during portions of the snowmelt season. The diurnal fluctuations in solids concentration are shown to be consistent with water temperature fluctuations. In 1988, the percentage of organics in the total suspended solids was scattered from 0% to 66% during the snowmelt season.

MP 3331

MOBILITY RESEARCH: WHERE WE HAVE BEEN AND WHERE WE ARE GOING.

Liston, R.A., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, July 1993, SR 93-17, International Conference on Winter Vehicle Mobility, 1st, Santa Barbara, CA, June 1991. Proceedings. Edited by G.L. Blaisdell, p.2-18, ADA-271 546.

48-1161

VEHICLES, ALL TERRAIN VEHICLES, MOTOR VEHICLES, SNOW VEHICLES, TRACKED VEHICLES, HISTORY, MILITARY EQUIPMENT, MILITARY RESEARCH, MILITARY TRANSPORTATION

MP 3332

PREDICTING VEHICLE MOBILITY ON SNOW-COVERED SLOPES.

Richmond, P.W., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, July 1993, SR 93-17, International Conference on Winter Vehicle Mobility, 1st, Santa Barbara, CA, June 1991. Proceedings. Edited by G.L. Blaisdell, p.20-28, ADA-271 546, 8 refs.

48-1162

VEHICLES, MOTOR VEHICLES, SNOW VEHICLES, TRACKED VEHICLES, MILITARY TRANSPORTATION, MATHEMATICAL MODELS, TIRES, TRACTION

Recently, a semi-empirical model for shallow snow mobility predictions was developed at CRREL in support of an evaluation of wheeled and tracked vehicles. These equations were developed from a large data base of traction and resistance data obtained on level snow-covered terrain using current U.S. Army military vehicles. Winter military operations will not be limited to level terrain; thus, it is important to be able to predict mobility characteristics on snow-covered sloped terrain as well. This paper describes a simple modification to the CRREL shallow snow mobility model to account for sloped terrain, and compares mobility predictions to go-no-go mobility tests on snow-covered slopes. Go-no-go data were available for nine vehicles (both wheeled and tracked), all obtained at the Keweenaw Research Center, MI, using their test slopes. Snow conditions ranged from a thin layer of hard-packed snow to 60 cm of 150 kg/cu m density snow. Go-no-go predictions using the model were correct for about 70% of the test data available. It was found that the surface underlying the snow may have more effect on traction on slopes than it does on level terrain, at least for shallow low-density snow layers.

MP 3333

EXPERIMENTAL METHOD FOR VEHICLE MOBILITY RESEARCH ON FREEZING/THAWING SOIL.

Shoop, S.A., Berliner, E., Decato, S., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, July 1993, SR 93-17, International Conference on Winter Vehicle Mobility, 1st, Santa Barbara, CA, June 1991. Proceedings. Edited by G.L. Blaisdell, p.29-37, ADA-271 546, 9 refs.

48-1163

VEHICLES, EXPERIMENTATION, COLD WEATHER PERFORMANCE, COLD WEATHER TESTS, FREEZE THAW TESTS

The Cold Regions Research and Engineering Laboratory has constructed a test basin where full scale vehicle mobility testing can be performed under simulated winter conditions. Although mobility testing is primarily performed on freezing and thawing soil, other surfaces can also be used. The test basin is 36.6 m long, 12.3 m wide and 3.6 m deep. The deeper part of the basin is filled with a gravelly sand in which a water table can be allowed to fluctuate. In the top 106 cm of the basin is the test soil, which is changed periodically. Refrigeration panels are used to freeze the soil from the top down. Soil moisture and temperature are monitored during the freeze/thaw and can be varied as desired. The soil parameters such as moisture, density, cone penetration, and strength are measured prior to vehicle testing. An instrumented Jeep Cherokee is used for traction and motion resistance testing. The vehicle has load cells and velocity sensors on the front wheels and both a sonic speed sensor and a fifth wheel to measure vehicle speed. The sensors are read and recorded using a computer-controlled data acquisition system. A typical test sequence consists of three traction and motion resistance tests, as well as a baseline hard surface resistance test, for each tire pressure or type.

MP 3334

OPERABILITY: THE FIRST STEP TO MOBILITY.

Diemand, D., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, July 1993, SR 93-17, International Conference on Winter Vehicle Mobility, 1st, Santa Barbara, CA, June 1991. Proceedings. Edited by G.L. Blaisdell, p.59-66, ADA-271 546, 6 refs.

48-1166

COLD WEATHER OPERATION, COLD WEATHER PERFORMANCE, EQUIPMENT, MACHINERY, HEATING, BATTERIES

All engineering equipment has some problems, even in ideal conditions. As winter approaches and temperatures fall, problems gradually become more frequent, more numerous, and more serious. At about 0 C their number rapidly increases as the performance of the soft and fluid elements of the engine and associated systems begins to deteriorate. Lubricants thicken, seals stiffen, batteries lose power and freeze, and ice forms in fuel lines, carburetors, and anywhere else water can possibly enter. Difficulty in engine starting is encountered. These problems slowly proliferate down to about -40 C at which temperature another rapid increase in problems occurs. This is because problems with hard parts are added to the gallery of already existing difficulties. Differential expansion and contraction of different metals cause jamming. Metals, rubbers, and other elastomers become brittle; structural members crack; push rods and cylinders break. Below this temperature, equipment operation becomes extremely difficult and in some cases impossible. Since very few vehicles are designed specifically for performance in cold regions, the remedies for these problems have largely resulted from local ingenuity fueled by the need of the moment. This paper describes some general solutions for many operational problems encountered at -40 C and below.

MP 3335

VISCOSITY MEASUREMENTS ON VERY WET SOILS.

Shoop, S.A., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, July 1993, SR 93-17, International Conference on Winter Vehicle Mobility, 1st, Santa Barbara, CA, June 1991. Proceedings. Edited by G.L. Blaisdell, p.156-163, ADA-271 546, 9 refs.

48-1174

VISCOSITY, SOIL WATER, THAW WEAKENING, GROUND THAWING, WATER CONTENT

Springtime and intermittent thaws are often accompanied by soft, wet ground conditions and thaw weakening of the soil. Water added during snow melt and spring rain accumulates in the thawed layer because drainage is limited by the relatively impermeable frozen soil below. This added water decreases the strength of the thawing soil even further. For these very wet soil conditions the soil can be considered a non-Newtonian viscous fluid. Information from viscosity tests can then be used in analytical or numerical models where the thawing soil is modeled as a semi-viscous fluid for determination of the drag resistance of wheels in viscous mud. This paper describes apparent viscosity measurements on three soil types—sand, silt and clay—chosen to

cover a wide range of grain sizes. Extensive mobility test data and supporting information, such as shearing resistance, grain size and Atterberg limits, were also readily available for each of the soils tested. Six to eight soil-water mixtures, ranging in consistency from a paste to a slurry, were tested for each soil type. The viscosity was found to be strongly influenced by water content, as expected. Below the liquid limit, when the soil samples were paste-like, the viscosity was very high (39 to 85 Pa.s), and was difficult to measure because the soils behaved as a semi-solid. At or near the liquid limit, the viscosity of all the soil types was approximately 40 Pa.s. As the percentage of water increased beyond the liquid limit, the viscosity decreased dramatically and then steadily declined as additional water was added. The lowest viscosity value measured, for very wet clay (over 100% water content), was approximately 0.07 Pa.s. In general, the values obtained in this study extend smoothly beyond the range of previously published data.

MP 3336

SNOW CHARACTERIZATION FOR TRACTION TESTING: A SURVEY OF TECHNIQUES USED.

Shoop, S.A., Alger, R., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, July 1993, SR 93-17, International Conference on Winter Vehicle Mobility, 1st, Santa Barbara, CA, June 1991. Proceedings. Edited by G.L. Blaisdell, p.186-189, ADA-271 546, 7 refs.

48-1177

SNOW SURFACE, TRACTION, TIRES, TESTS

A variety of techniques exist for the characterization of snow for vehicle mobility or tire traction testing. Snow surfaces that are used for testing are either natural or groomed and vary widely in strength and texture. To complicate the situation even further, tire testers perform their traction tests in a number of different manners. Snow characterization methods are discussed and the various techniques presented. This paper is the start of what hopefully will become a broad survey of most of the testing and characterization methods used by the several tire testing companies that perform these tests on a routine basis. This work is part of an ongoing effort between USACRREL and the Keweenaw Research Center.

MP 3337

FLEXTRAC MPV: A NOVEL CONCEPT IN A PERSONAL ALL-TERRAIN VEHICLE.

Osborne, M.D., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, July 1993, SR 93-17, International Conference on Winter Vehicle Mobility, 1st, Santa Barbara, CA, June 1991. Proceedings. Edited by G.L. Blaisdell, p.203-214, ADA-271 546.

48-1181

MILITARY TRANSPORTATION, ALL TERRAIN VEHICLES, TERRAIN

Personal vehicle mobility has entered a new age with the development of the Flextrac Multi-purpose Vehicle (MPV). Developed in Scandinavia, the Flextrac MPV utilizes a novel concept in vehicle mobility. Designed for one or two people, the Flextrac uses one single track, consisting of 36 flexible sections to propel and steer the vehicle through deep snow, sand and swamps. Because it does not have skis and slides as most current snowmobiles have today, it is capable of negotiating non-snow terrain. The track extends the entire length of the body and is considerably wider than snowmobile tracks, providing a light footprint and good flotation, even in soft snow or soils. The low ground pressure also contributes to less environmental damage than most vehicles. This vehicle was tested by the Keweenaw Research Center (KRC), a research agency of Michigan Technological University (MTU), over a wide variety of both summer and winter terrains, including deep powder snow, swamps, sand and swimming in a pond. Several performance tests were conducted to evaluate hill climbing capability, pulling capacity, acceleration, braking, towed motion resistance, turning radius and fuel consumption over a wide variety of terrains. The design concepts of the Flextrac MPV's undercarriage along with its performance capabilities are discussed and presented in this paper. This project was funded by the U.S. Army Tank-Automotive Command (TACOM) and the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL).

MP 3338

WAVE PROPAGATION IN ICE-COVERED CHANNELS.

Daly, S.F., *Journal of hydraulic engineering*, Aug. 1993, 119(8), p.895-910, 17 refs.

48-1242

HYDRAULICS, CHANNELS (WATERWAYS), UNSTEADY FLOW, ICE COVER EFFECT, ICE WATER INTERFACE, WATER WAVES, WAVE PROPAGATION, SPECTRA, ATTENUATION, ANALYSIS (MATHEMATICS)

The propagation of waves in ice-covered channels is analyzed using linearized forms of equations governing one-dimensional unsteady flow in rectangular ice-covered channels. The ice cover is assumed to be a relatively thin continuous elastic plate. Five well-defined bands of wave celerity are found in the wave-number spectrum. Three bands exist at wavelengths longer than about 20 characteristic lengths of the ice, and define the range of quasi-

open-channel wave propagation over which the wave celerities are analogous to open-channel wave celerities. Two bands exist at shorter wavelengths: an ice-coupled band and, at even shorter wavelengths, an acoustic band. The group velocity over the dispersive ice-coupled band is found to always exceed the wave celerities.

MP 3339

PASSIVE MICROWAVE MEASUREMENTS OF TUNDRA AND TAIGA SNOW COVERS IN ALASKA, U.S.A.

Sturm, M.A., Grenfell, T.C., Perovich, D.K., *Annals of glaciology*, 1993, Vol.17, International Symposium on Remote Sensing of Snow and Ice, Boulder, CO, May 17-22, 1992. Proceedings, p.125-130, 28 refs.

48-1310

SNOW SURVEYS, TUNDRA, TAIGA, REMOTE SENSING, RADIOMETRY, MICROWAVES, SNOW COVER STRUCTURE, GRAIN SIZE, SNOW COVER EFFECT, SNOW OPTICS, SNOW WATER EQUIVALENT, UNITED STATES—ALASKA

The microwave emissivity of two snow covers was measured in Alaska in Mar. 1990. Observations were made on taiga snow near Fairbanks that was 0.83 m thick with a 0.55 m thick basal layer of depth hoar. Other measurements were made on the tundra snow cover at Innayati Creek north of the Brooks Range, which was 0.27 to 0.64 m thick and consisted of two or more wind slabs overlying a depth hoar layer 0.14 to 0.26 m thick. Density, crystal structure and grain size were similar in tundra and taiga depth hoar layers. Emissivity was measured at 18.7 and 37 GHz using radiometers mounted on a 1.5 m tall bipod. Measurements were made on undisturbed snow, and then several snow layers were removed and additional measurements were made. For both snow covers, there was a marked reduction in the effective emissivity from that of the underlying ground, with a maximum reduction of about 30%. All of the reduction was found to occur within the depth hoar layer. Maximum reduction in effective emissivity could be caused by a depth hoar layer 0.3 m thick. Overlying wind slab or new snow were nearly "invisible", increasing the effective emissivity only by a small amount due to self-emittance. Thus it was difficult to distinguish the two different snow covers on the basis of their emissivity, since both contained 0.3 m of depth hoar or more.

MP 3340

TOWARDS PREDICTING TEMPORAL CHANGES OF THE SPECTRAL SIGNATURE OF SNOW IN VISIBLE AND NEAR-INFRARED WAVELENGTHS.

Davis, R.E., Nolin, A.W., Jordan, R., Dozier, J., *Annals of glaciology*, 1993, Vol.17, International Symposium on Remote Sensing of Snow and Ice, Boulder, CO, May 17-22, 1992. Proceedings, p.143-148, 22 refs.

48-1313

SNOW PHYSICS, SNOW COVER STRUCTURE, MICROSTRUCTURE, GRAIN SIZE, SNOW OPTICS, SOLAR RADIATION, HEAT BALANCE, REFLECTIVITY, SPECTRA, MATHEMATICAL MODELS

This study links two models, one that simulates changes in snow microstructure and one that recovers microstructure properties from measurements of snow reflectance. An energy and mass transfer model, SNTERM.89, was used to calculate snow grain growth. Grain sizes from the model and measurements of grain bond areas provided estimates of the surface-to-volume ratio of the bulk snow, which were transformed to geometrically-equivalent sphere sizes. An inversion technique based on a discrete-ordinate model of the directional reflectance recovered optically-equivalent sphere sizes from reflectance measurements at 1.075 microns. The predictions of equivalent sphere sizes from the snow model and the recovered optical sphere sizes from the inversion method were compared with stereological measurements from snow sections. The geometrically-equivalent and optically-equivalent grain sizes showed good agreement with each other and with stereological measurements from snow a few days old. The predictions of the reflectance inversion method also compared favorably with geometrically-equivalent grain sizes measured from a melt-freeze surface crust. This investigation shows the potential for fully coupling snow property simulations with models to predict the spectral reflectance of snow.

MP 3341

STEREOLOGICAL DETERMINATION OF DRY-SNOW PARAMETERS FOR DISCRETE-SCATTERER MICROWAVE MODELING.

Shi, J.C., Davis, R.E., Dozier, J., *Annals of glaciology*, 1993, Vol.17, International Symposium on Remote Sensing of Snow and Ice, Boulder, CO, May 17-22, 1992. Proceedings, p.295-299, 10 refs.

48-1338

SNOW PHYSICS, SNOW COVER, SNOW OPTICS, MICROSTRUCTURE, REMOTE SENSING, MICROWAVES, PARTICLE SIZE DISTRIBUTION, SCATTERING, STATISTICAL ANALYSIS, MODELS

Modeling of microwave backscattering and emission from snowpacks requires knowledge of snowpack characteristics and their

dynamics to select an appropriate model. Both theory and field data show that microwave backscattering coefficients and brightness temperatures are sensitive to parameters describing snow microstructure. Stereological methods and other techniques can be applied to images of sections cut from undisturbed snow, and are used to obtain accurate and unbiased estimates of snow microstructure parameters for discrete scatterer modeling. Assuming that the ice particle size distribution can be characterized as a log-normal distribution function, the authors show that the parameters describing the distribution can be obtained from section images. The results show that, in addition to snow density and ice particle size, the particle size variation has great effect on dry snow extinction properties. The optically equivalent ice particle size for Rayleigh scattering in a snowpack with grain size variations can be determined from the stereological measurements from snow sections.

MP 3342

FUNDAMENTALS OF SLUDGE DEWATERING IN FREEZING BEDS.

Martel, C.J., *Water science and technology*, 1993, 28(1), Specialised Conference on Wastewater Sludge Dewatering: Theoretical Methods, Experimental and Modelling Techniques, Full-scale Operation and Control, Aalborg, Denmark, June 29-July 1, 1992. Proceedings. Edited by J.A. Hansen et al, p.29-35, 8 refs.

48-1372

WASTE TREATMENT, WATER TREATMENT, WATER CHEMISTRY, SLUDGES, ARTIFICIAL FREEZING, COLD WEATHER PERFORMANCE, FREEZE THAW CYCLES, DESICCATION, MATHEMATICAL MODELS

After several years of research, the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) has developed a new unit operation for sludge dewatering called a freezing bed. The freezing bed uses natural freeze-thaw to dewater sludge. Essentially, it is the cold regions counterpart to the drying bed. Pilot and full-scale studies conducted in the United States have demonstrated that freezing beds can dewater both water and wastewater treatment sludges to greater than 20% total solids content. The best results were obtained with alum sludge, which was dewatered to 82% solids. The design of freezing beds will depend on the depth of sludge that can be frozen and thawed at the proposed site. Mathematical models capable of calculating the design depth are presented.

MP 3343

MID- TO LATE-HOLOCENE CARBON BALANCE IN ARCTIC ALASKA AND ITS IMPLICATIONS FOR FUTURE GLOBAL WARMING.

Marion, G.M., Oechel, W.C., *Holocene*, 1993, 3(3), p.193-200, 47 refs.

48-1381

GLOBAL WARMING, CLIMATIC CHANGES, GREENHOUSE EFFECT, PALEOCLIMATOLOGY, ARCTIC LANDSCAPES, ECOSYSTEMS, CARBON DIOXIDE, ORGANIC SOILS, SOIL PROFILES, SOIL AIR INTERFACE, CLIMATIC FACTORS, UNITED STATES—ALASKA

In the event of global warming, there is considerable uncertainty whether northern ecosystems will act as an atmospheric CO₂ sink or source. This study examines Holocene rates of soil carbon accumulation along a latitudinal transect in northern Alaska as an analog for future change in the Arctic. Both paleoclimatic and latitudinal trends support the argument that long-term carbon storage in far-northern ecosystems (arctic and subarctic) increases with increasing temperature. This suggests that far-northern ecosystems will, over the long term (centuries to millennia), continue to act as a small sink for atmospheric CO₂ following global warming, which will provide a small negative feedback on global warming. However, recent studies also suggest the possibility that over the short term (decades to centuries), overall carbon loss from the Arctic might also provide a strong positive feedback on global warming.

MP 3344

SNOW AND ICE APPLICATIONS OF AVHRR IN POLAR REGIONS: REPORT OF A WORKSHOP HELD IN BOULDER, COLORADO, 20 MAY 1992.

Steffen, K., et al, *Annals of glaciology*, 1993, Vol.17, International Symposium on Remote Sensing of Snow and Ice, Boulder, CO, May 17-22, 1992. Proceedings, p.1-16, 62 refs.

48-1293

MEETINGS, RESEARCH PROJECTS, GEOPHYSICAL SURVEYS, GLACIOLOGY, ICE SHEETS, SEA ICE, SNOW COVER, REMOTE SENSING, RADIOMETRY, SPACEBORNE PHOTOGRAPHY

This paper summarizes the ideas and recommendations from the 3rd International Symposium on Remote Sensing of Snow and Ice, which took place at Boulder, CO, May 17-22, 1992.

MP 3345

ARCTIC RESEARCH OF THE UNITED STATES, VOL.7.

U.S. Interagency Arctic Research Policy Committee,

Myers, C.E., ed, Bowen, S., ed, Cate, D.W., ed, Valiere, D.R., ed, Washington, D.C., Spring 1993, 70p., 37 refs.
48-1464

RESEARCH PROJECTS, ORGANIZATIONS, LEGISLATION, MEETINGS, COST ANALYSIS

MP 3346

ON THIN ICE: RADAR IDENTIFICATION OF THIN AND NOT SO THIN LAYERS IN HYDROLOGICAL MEDIA.

O'Neill, K., International Conference on Computational Methods in Water Resources, 7th, Cambridge, MA, June, 1988. Proceedings. Vol.1. Modeling surface and sub-surface flows. Edited by M.A. Celia et al. Developments in Water Science, No.35, Southampton, England, Computational Mechanics Publications, 1988, p.371-377, 4 refs.
48-1466

ICE SURVEYS, ICE COVER THICKNESS, ICE DETECTION, RIVER ICE, ICE WATER INTERFACE, RADIO ECHO SOUNDINGS, RADAR ECHOES

Many remote sensing systems have been tried or proposed for identifying interfaces in surface and subsurface media. As an example the author considers here the use of short pulse radar applied to ice layers. A computational system is required which will clearly mark reflections from interfaces while suppressing other unwanted responses as much as possible, so that automated layer detection is possible. This is achieved using a straight-forward band-limited inverse filter, modified by a time-dependent penalty weighing procedure. Contrasting model dependent techniques must be applied to reflections from thin ice, in which returns from top and bottom surfaces and multiples are not separated. The same techniques which succeed here should be applicable to other sufficiently non-dissipative media featuring layers with contrasting dielectric constants.

MP 3347

SATELLITE OBSERVATIONS OF OCEANS AND ICE.

Jezek, K.C., Hibler, W.D., III, International Conference on Computational Methods in Water Resources, 7th, Cambridge, MA, June, 1988. Proceedings. Vol.1. Modeling surface and sub-surface flows. Edited by M.A. Celia et al. Developments in Water Science, No.35, Southampton, England, Computational Mechanics Publications, 1988, p.379-382, 11 refs.
48-1467

ICE SURVEYS, SEA ICE DISTRIBUTION, ICE DETECTION, ICE CONDITIONS, SPACEBORNE PHOTOGRAPHY, SYNTHETIC APERTURE RADAR

MP 3348

RADAR SIGNATURE OF A 2.5-D TUNNEL.

Moran, M.L., Greenfield, R.J., *Geophysics*, Nov. 1993, 58(11), p.1573-1587, 18 refs.
48-1513

GEOPHYSICAL SURVEYS, SUBSURFACE INVESTIGATIONS, TUNNELS, DETECTION, BOREHOLES, RADAR ECHOES, WAVE PROPAGATION, ELECTROMAGNETIC PROSPECTING, MATHEMATICAL MODELS

The effects of an infinitely long cylindrical void on short-pulse cross-borehole radar waveforms are modeled and analyzed. The model is based on field solutions for a vertically oriented point-source electric dipole. A three-dimensional (3-D) analytical frequency domain derivation of Green's function is found using a spatial Fourier transform over the cylinder axis. The resulting wavenumber integral is evaluated by a numerical integration over wavenumber. Time-domain waveforms are produced by applying a Fourier transform to a 7-80 MHz band of frequencies in the Green's function spectrum. Model results agree well with available field data sets. Further modeling examines the effects on waveforms for a wide variety of cases in which the raypath is not orthogonal to the tunnel axis, including the effect of tunnel dip. An air-filled tunnel with a radius greater than 1.0 m produces a low amplitude shadow zone along its entire length. A low amplitude early arrival is observed in simulations with air-filled tunnels in which the source to receiver path forms an acute angle larger than 45 deg with the tunnel axis. This arrival is interpreted as propagation through the tunnel. When this angle is smaller than 45 deg the tunnel is effectively an opaque object and only the energy diffracted around the cylindrical void is observed. Waveform behavior gradually transitions from propagation through the tunnel in the vicinity of 45 deg.

MP 3349

ANALYTICAL METHOD FOR WHITE PHOSPHORUS RESIDUES IN MUNITIONS-CONTAMINATED SEDIMENTS.

Walsh, M.E., Taylor, S., *Analytica chimica acta*, 1993, Vol.282, p.55-61, 9 refs.
48-1526

MILITARY RESEARCH, WETLANDS, BOTTOM SEDI-

MENT, SOIL POLLUTION, EXPLOSIVES, EXPLOSION EFFECTS, ENVIRONMENTAL IMPACT, SOIL CHEMISTRY, CHEMICAL ANALYSIS

An analytical method is described to determine white phosphorus (P_4) in wetland bottom sediments contaminated by smoke munitions. Experiments were performed to promote the extraction of P_4 from saturated sediment with a nonpolar solvent. P_4 extraction was enhanced by adding water to form a sediment-water slurry prior to shaking with isooctane for up to 24 h. P_4 was determined with a portable capillary gas chromatograph equipped with a nitrogen-phosphorus detector. A certified reporting limit of 0.88 microgram/kg was estimated.

MP 3350

MECHANICAL FREEZING OF ALUM SLUDGE.

Martel, C.J., IAWQ 17th biennial international conference, Budapest, July 24-29, 1994. Water quality international '94. Conference preprint book 4, London, International Association on Water Quality, 1994, p.85-93, 9 refs.
48-5376

ARTIFICIAL FREEZING, WATER TREATMENT, WASTE TREATMENT, SEWAGE TREATMENT, SLUDGES, FREEZE DRYING

This paper presents a new mechanical freezing concept for freezing alum or other hydroxide sludges as a conditioning step for dewatering. The basic concept is to freeze a thin layer of sludge on a continuously moving fabric belt. Sludge is attached to the belt by a vacuum drum belt filter, which also removes one-half of the water and thus reduces the amount of sludge to be frozen. Filter leaf tests were conducted to determine the operational parameters and approximate production rates of this concept. The tests show that freezing alum sludge in thin layers will separate out the water as ice crystals and transform the solids into the same type of granular material produced in natural freezing beds. The average production rate of frozen sludge was 6.5 kg/hr/m² at -20 C. The belt area needed for a 10,000 m³/day plant was estimated to be 48 m². This concept has been patented by the U.S. Patent Office.

MP 3351

FRAZIL ICE CONCENTRATION METER.

Lever, J.H., Daly, S.F., Rand, J.H., Furey, D., IAHR International Symposium on Ice, Banff, Alberta, Canada, June 15-19, 1992. Proceedings, Vol.3, [1992], p.1362-1376, 8 refs.
48-1547

MEASURING INSTRUMENTS, FRAZIL ICE, RIVER ICE, ICE WATER INTERFACE, ICE VOLUME, DESIGN, CALORIMETERS, ICE FORECASTING, PERFORMANCE

Frazil ice forming in turbulent rivers causes a variety of problems, ranging from blockage of water intakes to ice-jam related flooding. Unfortunately, no validated method exists to measure frazil ice concentration. To rectify this situation, a portable calorimeter was constructed to measure frazil ice concentration in homogeneous, flowing ice/water mixtures. A pump draws a measured volume of mixture through a fine screen located in the center of the calorimeter chamber. The frazil collects on this screen and eventually blocks it. The chamber is then closed and a calorimetric measurement conducted to determine the mass of ice deposited. The ice concentration in the original mixture is then the measured mass divided by the measured volume pumped through the chamber. With the ice melted, the chamber is opened to renew the measurement cycle. Calibration tests have revealed the calorimeter's measurement uncertainty to be about +/- 10%. This paper describes the instrument and presents results of both calibration and proof-of-concept laboratory tests.

MP 3352

MODES OF ICE COVER FAILURE DURING SHOAVING AND THICKENING.

Zufelt, J.E., IAHR International Symposium on Ice, Banff, Alberta, Canada, June 15-19, 1992. Proceedings, Vol.3, [1992], p.1507-1514, 4 refs.
48-1559

ICE MECHANICS, RIVER ICE, ICE BREAKUP, ICE JAMS, ICE COVER STRENGTH, ICE COVER THICKNESS, HYDRAULICS, ICE SOLID INTERFACE, ARTIFICIAL ICE, MECHANICAL TESTS, SIMULATION

Observations from a series of experiments looking at the failure of river ice covers simulated by plastic beads are reviewed. The ice cover was caused to collapse and thicken by increasing the discharge beneath the cover. Two general modes of cover failure are identified. The characteristics of the plastic beads are calculated by the theory of granular, noncohesive soils. Pre- and post-failure cover thickness is calculated using equilibrium thickness theory and compared to the experimental measurements.

MP 3353

PERTURBATION TECHNIQUES IN PHASE CHANGE HEAT TRANSFER.

Aziz, A., Lunardini, V.J., *Applied mechanics reviews*, Feb. 1993, 46(2), p.29-68, 67 refs.
48-1604

PHASE TRANSFORMATIONS, HEAT TRANSFER, FREEZING, MELTING, BOUNDARY VALUE PROBLEMS, STEFAN PROBLEM, LIQUID SOLID INTERFACES,

MATHEMATICAL MODELS

Since the pioneering works of Neumann and Stefan, a number of analytical and numerical techniques have been developed to deal with freezing and melting problems. One such analytical tool is the method of perturbation expansions, which is the main focus of this work. The article begins with a review of the perturbation theory and outlines the regular perturbation method, the method of strained coordinates, the method of matched asymptotic expansions, and the recently developed method of extended perturbation series. Next, the applications of these techniques to phase change problems in Cartesian, cylindrical, and spherical systems are discussed in detail. The presentation is sufficiently detailed so that even the reader unfamiliar with perturbation theory can understand the material without much difficulty. At the same time, the discussion covers the latest literature on the subject and therefore should serve as a state-of-the-art review.

MP 3354

TIRE CHIPS AS SUBGRADE INSULATION—FIELD TRIAL.

Humphrey, D.N., Eaton, R.A., Symposium on Recovery and Effective Reuse of Discarded Materials and By-Products for Construction of Highway Facilities, Denver, CO, Oct. 19-22, 1993, 1993, 14p., Submitted paper. 16 refs.
48-1840

ROAD ICING, THERMAL INSULATION, FROST PENETRATION, FROST PROTECTION, SUBGRADES, TIRES, WASTE DISPOSAL

A test project using tire chips as an insulating layer to limit frost penetration beneath a gravel surfaced road is described. Tire chips, which are waste tires that have been cut into 50 mm (2 in.) to 300 mm (12 in.) pieces, are an attractive alternative to conventional insulation boards because they have a high thermal resistivity and are durable, free draining and low-cost. Furthermore, this application has the potential to make an important contribution to disposing of the more than 2 billion waste tires that are currently sitting in huge open piles across the United States. The project was constructed in Richmond, ME, in Aug., 1992. It is 230 m (750 ft) long and consists of five sections with different thicknesses of tire chips and overlying soil cover. In addition, there are two control sections. Over 20,000 waste tires were used on this project. The primary goals were to determine the thickness of tire chips needed to provide effective insulation and the minimum thickness of overlying soil cover needed to produce a stable riding surface. The thickness of the tire chip layer ranges from 152 mm (6 in.) to 305 mm (12 in.) while the thickness of the granular soil cover ranges from 305 mm (12 in.) to 610 mm (24 in.). The project is instrumented with thermocouples, resistivity gages, groundwater monitoring wells, and a weather station. In addition, the strength of the road surface is periodically measured with a heavy weight deflectometer. Results from the first year in service have shown that a 152 mm (6 in.) thick tire chip layer can reduce frost penetration by up to 40%. The gravel cover over the tire chips should be 305 to 457 mm (12 to 18 in.) thick to provide a stable riding surface.

MP 3355

HYGROSCOPIC AEROSOL GROWTH IN A STATIC COLD ENVIRONMENT.

Yen, Y.C., Smoke/Obscurants Symposium, 15th. Proceedings. Vol.2, 1991, p.507-519, 5 refs.
48-1841

AEROSOLS, HYGROSCOPIC NUCLEI, CONDENSATION NUCLEI, HETEROGENEOUS NUCLEATION, CLOUD DROPLETS, VAPOR DIFFUSION, HUMIDITY, COLD WEATHER OPERATION, MATHEMATICAL MODELS

An expression describing the instantaneous droplet growth under cold and static environment conditions was derived. This was done by solving the vapor diffusion equation with the method of Laplace transformation. The series solution, covering three temperature levels (0, -5 and -10 C) and four levels of relative humidity (25, 50, 75 and 100% of the saturation value), was expressed as functions of dimensionless parameters consisting of the ratio of vapor density over droplet surface to droplet density, the ratio of environmental vapor density at time zero to vapor density over droplet surface, and the ratio of product of diffusion coefficient and time to the square of the initial radius of the condensation nucleus. To take into account the variation of the vapor density over the surface of an acidic condensation nucleus due to the continuous dilution of the droplet, the solution was obtained by assuming various levels of constant vapor concentration. The final expression derived can be used to compute the value of the droplet radius once the values of the initial radius, relative humidity, percent of relative humidity at the droplet surface, and ambient temperature are given.

MP 3356

ELECTRICAL CONDUCTIVITY MEASUREMENTS FROM THE GISP2 AND GRIP GREENLAND ICE CORES.

Taylor, K.C., et al, *Nature*, Dec. 9, 1993, 366(6455), p.549-552, 36 refs.
48-1899

ICE CORES, ELECTRICAL RESISTIVITY, CLIMATIC CHANGES, GREENLAND

MP 3357
COMPARISON OF SAMPLE COLLECTION
AND HANDLING PRACTICES FOR THE ANAL-
YSIS OF VOLATILE ORGANIC COMPOUNDS
IN SOILS.

Hewitt, A.D., National Symposium on Measuring and Interpreting VOCs in Soils: State of the Art and Research Needs, Las Vegas, NV, Jan. 12-14, 1993, 1993, 6p., 11 refs.

48-1955

SOIL POLLUTION, SOIL CHEMISTRY, SOIL ANALYSIS, SOIL TESTS, DETECTION

MP 3358
VAPOR FORTIFICATION: A METHOD TO PRE-
PAIRE QUALITY ASSURANCE SOIL SAMPLES
FOR THE ANALYSIS OF VOLATILE ORGANIC
COMPOUNDS.

Hewitt, A.D., National Symposium on Measuring and Interpreting VOCs in Soils: State of the Art and Research Needs, Las Vegas, NV, Jan. 12-14, 1993, 1993, 6p., 6 refs.

48-1956

SOIL POLLUTION, SOIL CHEMISTRY, SOIL ANALYSIS, SOIL TESTS, DETECTION

MP 3359
H-POLARIZED SCATTERING FROM SINGLE
AND MULTIPLE ELONGATED CAVITIES.

Schiavone, G.A., O'Neill, K., Paulsen, K.D., *IEEE transactions on antennas and propagation*, Aug. 1993, 41(8), p.1122-1131, 24 refs.

48-2058

MICROWAVES, REMOTE SENSING, RESOLUTION, ANTENNAS, WAVE PROPAGATION, SCATTERING, POLARIZATION (WAVES), SURFACE ROUGHNESS, ANALYSIS (MATHEMATICS)

H-polarized scattering is investigated for perfectly conducting surfaces containing one, two, or many parallel grooves. For cases with many regularly spaced cavities, a Floquet and waveguide mode-matching scheme is used that incorporates the effects of a nonplanar, nonuniform incident beam, a corresponding receiving pattern, and a finite target size. Realistic simplification of the receiving pattern greatly reduces the computational requirements for the case of backscatter. The results highlight the significance of the finite beam and lab setting in surface scattering studies, and show grating type behavior for two or more scattering cavities. Parametric studies and spectral analysis for multiple-cavity structures suggest an ability to estimate individual cavity width and separation for sets of similar cavities, and to estimate cavity separation even for dissimilar cavities.

MP 3360
INFLUENCE OF LOW TEMPERATURE ON
ENERGY ABSORPTION IN LAMINATED COM-
POSITES.

Dutta, P.K., Faran, K.J.L., Hui, D., International Conference on Composite Materials (ICCM), 9th, Madrid, July 12-16, 1993. Proceedings, University of Zaragoza, Spain, 1993, p.311-320, 8 refs.

48-2061

COMPOSITE MATERIALS, LOW TEMPERATURE TESTS, IMPACT STRENGTH, PROJECTILE PENETRATION, MATHEMATICAL MODELS

This work focused over a wide temperature range, on the behavior of quasi-isotropic graphite/epoxy laminates subjected to an extremely short duration (140 microseconds) stress wave impact from a hemispherical indenter of a Hopkinson pressure bar apparatus. Energy absorption by the laminates was determined by using elementary stress wave propagation theory and the incident, reflected, and transmitted stress wave forms. The impacted laminates were then C-scanned to determine the extent of the damage resulting from the impact. Temperature influence on energy absorption at different impact velocities was determined and related to the micro-mechanics of the laminates. The experimental results were compared with results from numerical analysis using a modified version of the 3DIMPACT finite element code. The influence of low temperature and resulting matrix stiffening on energy absorption in the Hertzian deformation domain (low velocity) is predictable by the numerical analysis and is supported qualitatively by the experimental results.

MP 3361
FLEXURAL FATIGUE AND FRACTURE OF
UNIDIRECTIONAL GRAPHITE/EPOXY COM-
POSITES AT LOW TEMPERATURES.

Dutta, P.K., International Conference on Composite Materials (ICCM), 9th, Madrid, July 12-16, 1993. Proceedings, University of Zaragoza, Spain, 1993, p.866-874, 8 refs.

48-2062

COMPOSITE MATERIALS, LOW TEMPERATURE TESTS, FLEXURAL STRENGTH, FATIGUE (MATERIALS), FRACTURING

The fatigue behavior under flexural loading of unidirectional graphite/epoxy composites at several low temperatures has been studied. Reported measurements include the flexural moduli, yield stress, and fracture stress at temperatures from 20 to -40 C following 10^5 load cycles between approximately 20 and 80% of yield strength. Also, a summary is reported of the measurements procedure. Observations via scanning electron microscope (SEM) of the fracture surfaces are included. Upon fatigue loading, the strength, albeit scattered, increases with decreasing temperatures. However, the flexural moduli degraded with lower temperatures. The results are explained in terms of the influences of competing factors such as change of the constituents' thermoelastic properties and stresses at low temperatures. Finally, a simple phenomenological model is presented to explain the fracture development, which is based upon the competition between the buildup of tensile stresses and relaxation of compressive stresses following microfractures, and it leads to the low temperature's effects on the microstructural scale of the material.

MP 3362
STRESS WAVE PROPAGATION THROUGH
THE THICKNESS OF GRAPHITE/EPOXY LAM-
INATED PLATES USING PVDF SENSORS.

Hui, D., Dutta, P.K., Japan-U.S. Conference on Composite Materials, 6th, Orlando, FL, June 22-24, 1992. Proceedings, Lancaster, PA, Technomic Publishing Company, 1993, p.845-854, 11 refs.

48-2063

COMPOSITE MATERIALS, IMPACT STRENGTH, PROJECTILE PENETRATION, SHOCK WAVES

The object of this study was to determine the stress wave (or pulse) propagation through the thickness of a graphite-epoxy laminated plate. This was part of an overall study to understand the damage of these plates under normal projectile impact. Upon a sharp impact by a tiny spherical steel ball, the stress wave propagated from the impact point into the rest of the material. It was found that the embedded polyvinylidene fluoride (PVDF) sensors enabled prediction of the wave velocities and wave attenuation.

MP 3363
RADAR REFLECTION AND REFRACTION
PROFILES OF SEASONAL THAW OVER PER-
MAFROST IN FAIRBANKS, ALASKA.

Arcone, S.A., Lawson, D.E., Delaney, A.J., Government Workshop on Ground Penetrating Radar, 2nd, Columbus, OH, Oct. 26-28, 1993. Proceedings, Columbus, Ohio State University, 1993, 16p., 22 refs.

48-2064

PERMAFROST SURVEYS, PERMAFROST DEPTH, ACTIVE LAYER, THAW DEPTH, RADAR ECHOES, ELECTROMAGNETIC PROSPECTING, SUBSURFACE INVESTIGATIONS, UNITED STATES—ALASKA—FAIRBANKS

Radar reflection and refraction profiles were performed in late summer within the discontinuous permafrost near Ft. Wainwright in Fairbanks, AK. The profile line, a 300 m footpath, had no vegetative mat and consisted of about 1.5 m of unfrozen silt and sand above permafrost of frozen sands and gravels. Reflection and refraction profiles were obtained at pulse center frequencies of about 100 and 400 MHz. The reflection profiles showed a consistent reflection from the top of the permafrost. Refraction soundings showed air waves, dispersive ground modes traveling through the lower velocity thaw layer, and a refraction traveling through the higher velocity permafrost. The dielectric constants for the thawed and damp silt and sand were measured from the reflection profiles, and varied from 20 to 40. The dielectric constants for the permafrost were measured from the refraction profiles and varied from 5.3 to 5.6. These permafrost values are consistent with others obtained in this area during late winter using surface refractions, cross-borehole propagation, or diffraction asymptotes.

MP 3364
REMEDICATION OF PETROLEUM CONTAM-
NATED SOILS THROUGH BIOVENTING IN
COLD REGIONS.

Brar, G.S., Currier, P.M., Reynolds, C.M., Millhouse, J.B., National Conference, 14th, Washington, D.C., Nov. 30-Dec. 2, 1993. Superfund '93, [Greenbelt, MD, Hazardous Materials Control Resources (formerly Research) Institute], 1993, 5p., 15 refs.

48-2065

SOIL POLLUTION, SOIL MICROBIOLOGY, SOIL CHEMISTRY, LAND RECLAMATION, OIL SPILLS, COLD WEATHER OPERATION, COLD WEATHER PERFORMANCE, MILITARY FACILITIES

Petroleum contaminated soils are found in many remote sites in Alaska where releases from bulk storage of fuel oil for heat and power generation have occurred. Remediation of contaminated soil at remote sites under cold climates is expensive. Bioventing, a process in which petroleum degradation by indigenous aerobic bacteria is enhanced by supplying oxygen and nutrients, may be a viable treatment technique for soils at remote sites if limitations due to low temperatures can be overcome. The objectives of this study were to: 1) test a design for ex-situ bioventing in cold regions; 2) evaluate biodegradation rates at low temperatures; and 3) determine the effects of applied nutrients on low-temperature

biodegradation. Pit bioventing technology was shown to be efficient, fast, and cost-effective in cold regions where temperature during winter months is a major constraint for the remediation of contaminated soils.

MP 3365
FIELD MEASUREMENT OF HEAT LOSSES
FROM HOT WATER DISTRICT HEATING SYS-
TEMS.

Phetteplace, G.E., CLIMA 2000 Conference, London, Nov. 1-3, 1993. Proceeding, 1993, 10p., With French and German summaries. 9 refs.

48-2068

HEAT TRANSMISSION, HEAT PIPES, HEAT LOSS, HEAT TRANSFER, RADIANT HEATING, MILITARY FACILITIES

The heat losses that district heating systems experience under field operating conditions are not well known. This paper describes two field projects underway at U.S. Army bases where field measurements of heat loss are being made. At Fort Jackson, SC, a hot water district heating system with a supply temperature of 165 C is being monitored. Three different types of piping system constructions have been instrumented there. Two of the systems are of the steel conduit type and one is a concrete trench. At Ft. Irwin, CA, a hot water district heating system with a supply temperature of 85 C is being monitored. Two sites have been instrumented on this direct buried system which uses a preinsulated (polyurethane foam) piping system. The heat losses from these systems have been and are being monitored using several methods. Results from several years of monitoring are presented in this paper.

MP 3366
HEAT LOSSES FROM OPERATING HOT
WATER DISTRICT HEATING SYSTEMS.

Phetteplace, G.E., UNICHAL Conference, 26th, Paris, June 8-10, 1993. Proceeding. Vol.3, Zurich, International Union of Heat Distributors (Union Internationale des Distributeurs de Chaleur), 1993, 16p., With German and French summaries. 12 refs.

48-2069

HEAT TRANSMISSION, HEAT PIPES, HEAT LOSS, HEAT TRANSFER, RADIANT HEATING, MILITARY FACILITIES

The heat losses from district heating systems under field operating conditions are not well known. This paper describes two field projects underway at U.S. Army bases where field measurements of heat losses are being made. At Fort Jackson, SC, a hot water district heating system with a supply temperature of 165 C is being monitored. Three different types of piping system constructions have been instrumented there. Two of the systems are of the steel conduit type and one is a concrete trench. At Ft. Irwin, CA, a hot water district heating system with a supply temperature of 85 C is being monitored. Two sites have been instrumented on this direct buried system which uses a preinsulated (polyurethane foam) piping system. The heat losses from these systems have been and are being monitored by several methods. Results from several years of monitoring are presented in this report.

MP 3367
CRREL'S FIRST 25 YEARS, 1961-1986.

U.S. Army Cold Regions Research and Engineering Laboratory, Wright, E.A., ed, Hanover, NH, 1986, 61p.

48-2070

ORGANIZATIONS, LABORATORIES, RESEARCH PROJECTS, HISTORY

MP 3368
MILLIMETER-WAVE FM-CW RADAR FOR
AUTOMATIC, CONTINUOUS RIVER STAGE
MEASUREMENT.

Yankielun, N.E., Ferrick, M.G., Canadian Hydrotechnical Conference, 11th, Fredericton, New Brunswick, Canada, June 8-11, 1993. Canadian Society for Civil Engineering, 1993, p.107-118, 10 refs.

48-2084

RIVER FLOW, WATER LEVEL, ICE BREAKUP, ICE COVER EFFECT, ICE WATER INTERFACE, ICE AIR INTERFACE, ICE OPTICS, REFRACTIVITY, SENSORS, RADAR ECHOES, PERFORMANCE, DESIGN, FLOOD FORECASTING

A high-resolution, broadband millimeter-wave (26.5 to 40 GHz) Frequency Modulated-Continuous Wave (FM-CW) radar, with real-time data acquisition and digital signal processing capability, was mounted from fixed locations on bridges over the Connecticut River to continuously acquire, process, store, and display river stage data during controlled releases of water from a hydro-power dam. The radar system provided continuous stage data of accuracy comparable to those acquired by a survey team and a permanent U.S. Geological Survey stream gaging station. The system can be rapidly installed and is capable of acquiring data, including event timing, at 1-, 10-, or 60-second intervals, around-the-clock, without operator interaction or visual readings. The system sensor can be remotely mounted and monitored, thereby minimizing personnel safety hazards involved with direct visual measurement techniques. Included in the test protocol were radar

sensing events of an ice-covered river during ice-breakup. The system was successful in acquisition of ice cover thickness data.

MP 3369

ON THE STRUCTURE OF THREE-DIMENSIONAL SHEAR FLOWS.

Hopkins, M.A., Jenkins, J.T., Louge, M.Y., *Mechanics of materials*, 1993, Vol.16, p.179-187, 9 refs. 48-2085

RHEOLOGY, SHEAR FLOW, MASS FLOW, MASS MOVEMENTS (GEOLOGY), MICROSTRUCTURE, STRUCTURAL ANALYSIS, MECHANICAL PROPERTIES, ANISOTROPY, SIMULATION

This paper describes an investigation of structure in moderately dilute three-dimensional shear flows. Structure is defined as a dynamic inhomogeneity or fluctuation in the spatial concentration field. Numerical experiments are performed with large numbers of identical frictionless inelastic spheres. The spheres are contained in a fully periodic cubic control volume. Visual inspection of the spatial concentration field reveals a strong tendency for spheres with a low coefficient of restitution to form dense elongated clouds. The major axis of the clouds tends to align itself in the direction of the mean velocity and perpendicular to the direction of variation in the mean velocity created by the moving periodic images of the control volume.

MP 3370

SEEKING SOLUTIONS FOR ICING AT DAMS AND HYDRO PLANTS.

Haynes, F.D., *Hydro review*, Dec. 1993, p.58-64, 1 ref. 48-2086

DAMS, LOCKS (WATERWAYS), WATER INTAKES, ICING, CLASSIFICATIONS, COUNTERMEASURES, ICE CONTROL, ICE PREVENTION, ICE REMOVAL

Icing problems at hydro plants cause considerable loss of power generation, and thus revenue, every year. As reviewed in this paper, the Corps of Engineers is sharing information about solutions to the problem and researching new ways to eliminate ice.

MP 3371

NEW AND RECYCLED PLASTIC COMPOSITES FOR ROADSIDE SAFETY HARDWARE.

McDevitt, C.F., Dutta, P.K., *Plastic in building construction*, Nov. 1993, 18(2), p.6-12, 12 refs. 48-2093

PLASTICS, COMPOSITE MATERIALS, CONSTRUCTION MATERIALS, REINFORCED CONCRETES, ROAD MAINTENANCE, SUPPORTS, PILES, SAFETY, MECHANICAL TESTS, CREEP

A feasibility study on making roadside safety hardware from composite materials and recycled plastics has been undertaken. Included in this study is the problem of creep in reinforcing bars made from composite materials. Initial results indicate that creep in reinforcing bars made from thermoset composite materials will be within acceptable limits. Prototype designs and tests were made with recycled plastic lumber for the guardrail posts and blockouts. Results indicate that rigorous control of the constituents and their orientation and distribution within the composites is essential to develop reliable and predictable properties. Prototype sections of glass fiber-reinforced plastic W-beam rails have been produced but have not yet been crash-tested. Initial results show that these new materials could replace the conventional materials, i.e., steel, aluminum, concrete and wood. Moreover, the use of recycled plastic in high volume highway hardware applications would be desirable to ameliorate the national problems of available landfill space.

MP 3372

COMPOSITES FOR ROADSIDE HARDWARE.

Dutta, P.K., McDevitt, C.F., Pacific Rim Forum on Composite Materials, 3rd, Honolulu, Nov. 2-4, 1993, 1993, 14p., 12 refs. 48-2094

COMPOSITE MATERIALS, IMPACT STRENGTH, ROAD MAINTENANCE, HIGHWAY PLANNING, SAFETY

It is possible for designs utilizing new materials to be economically competitive for roadside safety devices. A feasibility study of making roadside safety hardware from composite materials and recycled plastics has been undertaken. Included in this study is the problem of creep in reinforcing bars made from composite materials. Initial results indicate that creep in reinforcing bars made from thermoset composite materials will not be a problem. Prototype designs and tests were made with recycled plastic lumber for the guardrail posts and blockouts. Results indicate that rigorous control of the constituents and their orientation and distribution within the composites is essential to develop reliable and predictable properties. Prototype sections of glass fiber-reinforced plastic W-beam rails have been produced but have not yet been crash-tested. Initial results show that these new materials could replace the conventional materials, i.e., steel, aluminum, concrete and wood. Moreover, the use of recycled plastic in high volume highway hardware applications would be desirable to ameliorate the national problems of available landfill space.

MP 3373

THIRD STOKES PARAMETER EMISSION FROM A PERIODIC WATER SURFACE.

Johnson, J.T., Kong, J.A., Shin, R.T., Staelin, D.H., O'Neill, K., Lohanick, A.W., *IEEE transactions on geoscience and remote sensing*, Sep. 1993, 31(5), p.1066-1080, 10 refs. 48-2109

REMOTE SENSING, RADIOMETRY, WIND DIRECTION, OCEANOGRAPHY, SEA STATES, SURFACE ROUGHNESS, BRIGHTNESS, THERMAL RADIATION, SCATTERING, SIMULATION, ANALYSIS (MATHEMATICS)

An experiment in which the third Stokes parameter thermal emission from a periodic water surface was measured is documented. This parameter is shown to be related to the direction of periodicity of the periodic surface and to approach brightness of up to 30 K at X-band for the surface used in the experiment. The surface actually analyzed was a "two-layer" periodic surface; the theory of thermal emission from such a surface is derived and the theoretical results are found to be in good agreement with experimental measurements. These results further the idea of using the third Stokes parameter emission as an indicator of wind direction over the ocean.

MP 3374

ARCTIC RESEARCH OF THE UNITED STATES, VOL.7.

U.S. Interagency Arctic Research Policy Committee, Myers, C.E., ed, Bowen, S., ed, Cate, D.W., ed, Valiere, D.R., ed, Washington, D.C., Fall 1993, 99p., Refs. passim. Includes index for vols. 1-6. For selected papers see 48-2123 through 48-2125. 48-2122

RESEARCH PROJECTS, ORGANIZATIONS, INTERNATIONAL COOPERATION, ENVIRONMENTAL PROTECTION, REGIONAL PLANNING, MEETINGS

MP 3375

CRREL RETROSPECTIVE 1986-1991.

U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH, [1992], 23p. 48-2132

ORGANIZATIONS, LABORATORIES, RESEARCH PROJECTS, HISTORY

MP 3376

BRAKING TRACTION ON SANDED ICE.

Borland, S.L., Blaisdell, G.L., *Transportation research record*, 1992, No.1387, p.79-85, 7 refs. 48-2220

ROAD ICING, RUNWAYS, ICE CONTROL, VEHICLES, TRACTION, SKID RESISTANCE, TEMPERATURE EFFECTS, SANDS, FINES, PHYSICAL PROPERTIES, RUBBER ICE FRICTION, COLD WEATHER PERFORMANCE

Traction enhancement on iced pavements using abrasives was evaluated. The abrasives tested were five distinct gradations of sand built from a single host material. Four of the sands represented standard gradations as specified by the FAA, SAE, ASTM, and Transport Canada. Braking traction at a relatively fixed slip rate was measured with a full-size, self-contained instrumented vehicle. All tests were performed on an ice sheet inside a large refrigerated room. Results showed that coarse sands perform best on cold ice surfaces and that finer sands excel on warm ice. Sands with most of their grains about 1 to 2 mm in diameter performed well independent of ice temperature. The concentration of a sand on ice strongly influences the degree of traction enhancement, as does the temperature of the sand when applied to the ice. The results suggest that a mathematical expression could be generated that would relate sand type and concentration, along with several other influential parameters, to braking traction coefficient on ice.

MP 3377

IMPROVING WINTER PAVEMENT PERFORMANCE.

Darling, M., Berg, R.L., *APWA reporter*, Oct. 1993, p.18. 48-2328

PAVEMENTS, COLD WEATHER PERFORMANCE, RESEARCH PROJECTS

MP 3378

VECTOR ANALYSIS OF ICE-FABRIC DATA.

Ferrick, M.G., Claffey, K.J., *Journal of glaciology*, 1993, 39(132), p.292-302, 19 refs. 48-2392

SEA ICE, MECHANICAL PROPERTIES, ICE CRYSTAL STRUCTURE, ORIENTATION, ANISOTROPY, STATISTICAL ANALYSIS, ANALYSIS (MATHEMATICS)

The mechanical properties of ice are strongly affected by crystal texture and c-axis alignment. This paper develops a general quantitative method for analysis of uniaxial crystal-orientation data. These data are represented as unit vectors from the origin with end points on the surface of a unit sphere. An orthogonal least-squares error measure is used to develop equations that define the closest plane and line through the data. Also, a method

is developed to transform the data and the results for viewing on Schmidt nets drawn in the best plane and the predominant basal plane of a sample, in addition to the standard xy-plane. Applications of the analysis to sea-ice samples include both numerical and Schmidt-net presentations of results.

MP 3379

DYNAMIC STUDY OF COMMON WELL SCREEN MATERIALS.

Hewitt, A.D., *Ground water monitoring review*, 1994, Vol.14, p.87-94, 18 refs. For another version see 48-719. 48-2453

GROUND WATER, MONITORS, SAMPLING, ACCURACY, CHEMICAL COMPOSITION, WELL CASINGS, CORROSION, LEACHING, ENVIRONMENTAL TESTS

Experiments simulating the dynamics of compliance sampling via a monitoring well were performed to assess the effects of common well screen materials (rigid polyvinyl chloride, polytetrafluorethylene, stainless steel 304, and stainless steel 316) on several metals and trichloroethylene (TCE) in ground water. This was achieved by using a continuous flow-through chamber system capable of exposing monitoring well screens to ground water for periods ranging from 0.25 to 8 hours. The findings of this study are more representative than static laboratory experiments for assessing the potential effects which well casing materials have on ground water samples. Under dynamic flow conditions stainless steel 304 and 316 screens were found to influence solution concentrations of Pb, Cd, Cr, Ni, and Fe, while ground water TCE concentrations were not affected by any of the materials tested.

MP 3380

BOTTOM TEMPERATURES OF SKATING SKIS ON SNOW.

Colbeck, S.C., *Medicine and science in sports and exercise*, 1994, 26(2), p.258-262, 7 refs. 48-2632

SKIS, SLIDING, PERFORMANCE, WOOD SNOW FRICTION, ICE SOLID INTERFACE, HEATING, SURFACE TEMPERATURE, TEMPERATURE DISTRIBUTION, TEMPERATURE MEASUREMENT, LOADING, THERMAL ANALYSIS, PLASTICS SNOW FRICTION

Thermocouples provide information about ski and skier performances and snow conditions. V1 skating technique superimposed a strong, cyclic signal on the general heating due to friction. The power spectra of these cycles gave information about the skier's technique. The greatest temperature response at the base of a skating ski was just behind the foot, where the ski is heavily loaded. The longitudinal profiles showed generally increasing temperatures along the length of the ski. Harder, more durable waxes are needed behind the foot, where most of the weight is carried, but the gliding temperatures are highest there. Heating increased with both speed and solar input. Solar radiation absorption heats the ski base directly and raises its temperature considerably. The color of the ski base and the amount of sunshine should be considered when choosing a wax.

MP 3381

RADAR BACKSCATTER MEASUREMENTS FROM SIMULATED SEA ICE DURING CRRELEX '90.

Beaven, S.G., Gogineni, S.P., Gow, A.J., Lohanick, A.W., Jezek, K.C., *Kansas University. Radar Systems and Remote Sensing Laboratory. Technical report*, June 1993, RSL-TR-8243-2, 134p., ADA-271 034, 28 refs. 48-2645

ICE SURVEYS, SEA ICE DISTRIBUTION, ICE DETECTION, ICE CONDITIONS, ENVIRONMENTAL TESTS, BACKSCATTERING, RADAR ECHOES, MATHEMATICAL MODELS

MP 3382

LOW-TEMPERATURE ADMIXTURES FOR CONCRETE.

Korhonen, C.J., Cortez, E.R., Charest, B.A., Smith, C.E., Jr., International Cold Regions Engineering Specialty Conference, 7th, Edmonton, Alberta, Mar. 7-9, 1994. Proceedings. Edited by D.W. Smith and D.C. Sego. Cold regions engineering: "A global perspective", Montreal, Canadian Society for Civil Engineering, 1994, p.87-96, 8 refs. 48-3354

CONCRETE ADMIXTURES, WINTER CONCRETING, CONCRETE CURING, CONCRETE STRENGTH

Portland cement concrete cannot be cured in cold weather without some form of thermal protection. Optimally, concrete should be cured at temperatures between 10 and 20 C and at relative humidities of at least 80%, conditions rarely met in the field. Lower temperatures slow the hydration rate of cement, which delays strength gain and increases the amount of time before forms can be removed safely. If the temperature dips too low, the mix water will freeze, causing irreparable strength loss. The usual method of combatting these undesirable low-temperature

effects is to control the environment of the fresh concrete, keeping it warm until it can safely be exposed to the weather. An alternative approach to thermal protection is the use of chemical admixtures that help concrete to develop adequate strength at low temperature. This paper reports on a laboratory investigation and product development of various chemical formulations used as low-temperature admixtures. The experimental results show that these chemical admixtures are capable of promoting strength in cold cured concrete that meets today's construction standards.

MP 3383

LARGE AIRCRAFT WINTER OPERATIONS AT SMALL AIRPORTS: A PROGRESS REPORT.

Berg, R.L., Government Workshop on Ground Penetrating Radar, Columbus, OH, Oct. 26-28, 1993. Proceedings, Columbus, Ohio State University, 1993, 15p.

48-2696

AIRPORTS, RUNWAYS, COLD WEATHER OPERATION, FROST HEAVE, FROST PENETRATION, FROST FORECASTING, TRAFFICABILITY, UNITED STATES—NORTH DAKOTA

In mid-1992 the FAA received a request from airport officials at Williston, ND to allow heavy aircraft to operate at Sloulin Field International Airport during the winter months. The FAA contacted CRREL and a field study was launched in late 1992 to verify the practicality of this request. Three sites at the airport were instrumented with temperature sensors, moisture sensors and electrical resistance gages to depths of about 10 ft. The North Dakota Department of Transportation agreed to conduct FWD tests on a monthly basis throughout the year. All of the data are being collected for the purpose of generating quantitative data for making decisions about when larger aircraft can be allowed at the airport. This paper presents results from the first winter of observations, and the possibility of allowing the larger aircraft during the winter, on a structural basis, is great.

MP 3384

THEORETICAL MODEL OF ULTRAVIOLET LIGHT TRANSMISSION THROUGH ANTARCTIC SEA ICE.

Perovich, D.K., *Journal of geophysical research*, Dec. 15, 1993, 98(C12), p.22,579-22,587, 43 refs.

48-3005

MARINE BIOLOGY, SEA ICE, OPTICAL PROPERTIES, ULTRAVIOLET RADIATION, ICE COVER EFFECT, SUBGLACIAL OBSERVATIONS, SCATTERING, LIGHT TRANSMISSION, SNOW COVER EFFECT, MATHEMATICAL MODELS

To assess the impact of enhanced incident ultraviolet irradiance on the sea ice microbial community, a knowledge of the amount of light transmitted through a sea ice cover is necessary. A two-stream radiative transfer model is used here to estimate the penetration of ultraviolet radiation through antarctic sea ice. Sea ice optical properties were used as proxies to infer scattering and absorption coefficients at ultraviolet wavelengths. Case studies are reported for sea ice in McMurdo Sound and in the Weddell Sea. Values of spectral transmittance are computed as well as integrated transmitted UV-B, UV-A, biologically effective irradiance (BEI), and photosynthetically active radiation (PAR). UV-B light levels under meter-thick ice are a few percent of incident values. The presence of a snow cover results in a large decrease in transmitted ultraviolet. Snow and ice ameliorate the biological impact of enhanced levels of incident ultraviolet radiation by reducing the BEI relative to the PAR. (Auth. mod.)

MP 3385

STANDARD TEST METHODS FOR DETERMINING AIR CHANGE IN A SINGLE ZONE BY MEANS OF A TRACER GAS DILUTION.

American Society for Testing and Materials, Flanders, S.N., Annual book of ASTM standards. ASTM designation E741-93, Philadelphia, PA, 1993, 16p., 8 refs.

48-2700

BUILDINGS, VENTILATION, AIR LEAKAGE, AIR FLOW, VAPOR TRANSFER, WEATHERPROOFING, STANDARDS

MP 3386

TERRESTRIAL COMPONENT OF THE CRYOSPHERE.

Me'nikov, P.A., Street, R.B., Lunardini, V.J., Climate change 1992. The supplementary report to the IPCC [Intergovernmental Panel on Climate Change] impacts assessment. Edited by W.J.M. Tegart and G.W. Sheldon, Canberra, Australian Government Publishing Service, 1993, p.94-102, 33 refs.

48-2705

PERMAFROST DISTRIBUTION, PERMAFROST FORECASTING, PERMAFROST HEAT BALANCE, GLACIER MASS BALANCE, CLIMATIC CHANGES, GLOBAL WARMING

MP 3387

DEVELOPMENT OF AN AIRBORNE MILLIMETER-WAVE FM-CW RADAR FOR MAPPING RIVER ICE.

Yankielun, N.E., Ferrick, M.G., Weyrick, P.B., *Canadian journal of civil engineering*, 1993, 20(6), p.1057-1064, With French summary. 18 refs. For another version see 47-2757.

48-2816

RIVER ICE, ICE CONDITIONS, ICE SURVEYS, SENSOR MAPPING, ICE COVER THICKNESS, PROFILES, AIRBORNE RADAR, RADAR ECHOES, RESOLUTION, ICE CRYSTAL OPTICS, SCATTERING

Analyses of a river's freezeup cover stability and its breakup rely on detailed knowledge of the cover's thickness and the variability of that thickness. A high-resolution millimeter wave (26.5-40 GHz) frequency modulated-continuous wave radar with real-time data acquisition and digital signal processing and display capability was deployed from a low-flying (3-10 m) helicopter to continuously acquire, process, and display data during an ice thickness profiling survey of a 24 km study reach. A nominal sheet ice thickness of 50 cm, occasional areas of new ice sheet as thin as 5 cm, open leads, and massive ice accumulations of the order of 5 m thick were encountered. Radar profiling data agreed with ground truth from borehole measurements of the sheet ice, and provided a more detailed view of the ice conditions than that obtained from a low altitude video survey. The radar system provided rapid, safe, and accurate data acquisition, allowing detailed mapping of the ice conditions throughout the reach.

MP 3388

PROCEEDINGS.

International Symposium on Snow and Snow-related Problems, Nagaoka, Japan, Sep. 14-18, 1992, Colbeck, S.C., ed, Albert, M.R., ed, Brown, R.L., ed, Brun, E., ed, McClung, D.L., ed, Wakahama, G., ed, *Annals of glaciology*, 1993, Vol.18, 342p., Refs. passim. For individual papers see 48-2818 through 48-2874.

48-2817

MEETINGS, GLACIOLOGY, SNOW SURVEYS, SNOW COVER STRUCTURE, METAMORPHISM (SNOW), SNOW COVER STABILITY, AVALANCHE MECHANICS, AVALANCHE MODELING, AVALANCHE FORECASTING, SNOW PHYSICS, SNOW MECHANICS, SENSORS

MP 3389

CONNECTIVITY OF SNOW PARTICLES.

Itagaki, K., Lemieux, G.E., *Annals of glaciology*, 1993, Vol.18, International Symposium on Snow and Snow-related Problems, Nagaoka, Japan, Sep. 14-18, 1992. Proceedings. Edited by S.C. Colbeck et al, p.7-10, 7 refs.

48-2819

SNOW COVER STRUCTURE, PHYSICAL PROPERTIES, SNOW OPTICS, LASERS, PHOTOGRAPHIC TECHNIQUES, LIGHT TRANSMISSION, LIGHT SCATTERING

An optical system potentially suitable for quantitative characterization of snow was conceived and tested. The system uses a laser beam to scan a thick section of snow impregnated with an opaque medium and observes light transmission through the slab.

MP 3390

SOME NUMERICAL EXPERIMENTS ON FIRN VENTILATION WITH HEAT TRANSFER.

Albert, M.R., *Annals of glaciology*, 1993, Vol.18, International Symposium on Snow and Snow-related Problems, Nagaoka, Japan, Sep. 14-18, 1992. Proceedings. Edited by S.C. Colbeck et al, p.161-165, 9 refs.

48-2845

SNOW AIR INTERFACE, SNOW COVER STRUCTURE, FIRN, SNOW TEMPERATURE, TEMPERATURE GRADIENTS, VENTILATION, ATMOSPHERIC PRESSURE, SNOW HEAT FLUX, MATHEMATICAL MODELS

Preliminary estimates of the thermal signature of ventilation in polar firn are obtained from two-dimensional numerical calculations. The simulations show that spatially varying surface pressure can induce airflow velocities of 10^{-5} m/s at 1.5 m depth in uniform firn, and higher velocities closer to the surface. The two-dimensional heat transfer results generally agree with earlier one-dimensional conclusions that the thermal effects of ventilation tend to decrease the temperature gradient in the top portions of the pack. Field observations of ventilation through temperature measurements are most likely to be observed when the firn temperature at depths of the order of 10 m is close to the air temperature, since steep temperature gradients can mask the thermal effects of ventilation. Preliminary indications are that as long as surface-pressure amplitude is sufficient to move the air about in the top tens of centimeters in the snow, the resulting temperature profile during ventilation is fairly insensitive to the frequency of the surface-pressure forcing for pressure frequencies in the range of 0.1-10.0 Hz.

MP 3391

STRUCTURE AND WIND TRANSPORT OF SEASONAL SNOW ON THE ARCTIC SLOPE OF ALASKA.

Benson, C.S., Sturm, M.A., *Annals of glaciology*, 1993, Vol.18, International Symposium on Snow and Snow-related Problems, Nagaoka, Japan, Sep. 14-18, 1992. Proceedings. Edited by S.C. Colbeck et al, p.261-267, 16 refs.

48-2864

ARCTIC LANDSCAPES, TUNDRA, SNOW COVER STRUCTURE, SNOW DEPTH, SNOW ACCUMULATION, SEASONAL VARIATIONS, SNOWDRIFTS, SAMPLING, BLOWING SNOW, WIND DIRECTION, SNOW AIR INTERFACE, UNITED STATES—ALASKA

The winter snow on the arctic slope of Alaska lasts for nine months each year, yet little is known about it from a scientific point of view. Its quality has been seriously underestimated (by a factor of three) in the weather service records, and the directions and magnitudes of wind-transported snow were unknown before the studies reported here. The authors' measurements of snow on the tundra indicate two major types which differ in depth, density, overall structure, and thermal characteristics: the veneer facies, lying on and interacting with the tundra, and the drift facies which forms in certain topographic settings. The flux of windblown snow was determined by repeated measurements on three carefully selected "drift traps", such as river banks, which are large enough that they do not fill during the winter. The measurements span 30 years to show year-to-year variability. The largest transport of snow is from the prevailing easterly winds; about half as much is transported by storm winds from the west. The lowest amount is transported by katabatic drainage winds which flow from the south out of the Brooks Range; they extend a variable, and largely unknown, distance northward onto the arctic slope before they yield to the stronger easterly and westerly winds.

MP 3392

PROCEEDINGS OF THE JOINT 50TH ANNUAL EASTERN SNOW CONFERENCE AND 61ST ANNUAL WESTERN SNOW CONFERENCE, QUEBEC, JUNE 8-10, 1993.

Eastern Snow Conference and Western Snow Conference, Ferrick, M.G., ed, Pangburn, T., ed, 1993, 441p., Refs. passim. For individual papers see 48-2921 through 48-2973.

48-2920

SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW-MELT, SNOW WATER EQUIVALENT, SNOW HYDROLOGY, SNOW DEPTH, SNOWFALL, SNOW COVER EFFECT, SNOW COMPOSITION, RUNOFF FORECASTING

MP 3393

GROUNDWATER TEMPERATURES DURING THE WINTER IN A FORESTED BASIN.

Calkins, D.J., *Eastern Snow Conference and Western Snow Conference. Proceedings*, 1993, Joint 50th and 61st, p.19-23.

48-2923

SNOW COVER EFFECT, SNOW HEAT FLUX, SNOW THERMAL PROPERTIES, GROUND WATER, WATER TEMPERATURE, SOIL TEMPERATURE, FOREST LAND

Vertical groundwater temperature profiles were measured in shallow (1-4 m) 5.08 cm-diameter PVC wells at several sites within a small (0.47 km²) deciduous forested basin. All sites except one indicated that conduction was the predominant means of heat transport, as was evident by the profiles being close to linear with depth. At one site the temperature was uniform with depth, indicating that advecting fluid kept the temperature profile shape from changing significantly during the entire fall or winter season. By the end of winter and just prior to snowmelt, groundwater temperatures at the 2 m depth ranged between 2 and 4.25 °C, and were warmest at the highest elevations in the basin. The spatial variability in groundwater temperatures at the 2 m depth at all sites was nearly 2 °C throughout the winter period. The presence of a snow cover minimizes the infiltration of rainwater and the subsequent advection of heat to the soil. A preliminary analysis of the data has shown that late in winter, the assumption of a steady state heat flux can be made. Vertical upward velocities in saturated soil regions on the order of 0.05 m/day were computed from a one-dimensional steady state heat and mass flow analysis using the temperature profiles.

MP 3394

RIVER ICE CONDITIONS DETERMINED FROM ERS-1 SAR.

Gatto, L.W., *Eastern Snow Conference and Western Snow Conference. Proceedings*, 1993, Joint 50th and 61st, p.113-122, 10 refs.

48-2935

RIVER ICE, ICE CONDITIONS, ICE SURVEYS, ICE REPORTING, SPACEBORNE PHOTOGRAPHY, SYNTHETIC APERTURE RADAR

CRREL has received digital data for 15 European Space Agency (ESA) European Remote Sensing (ERS) Satellite-1 synthetic aperture radar (SAR) images of the St. Marys, Connecticut and

White Rivers, acquired from Dec. 16, 1992 to May 5, 1993. Satellite-borne SARs such as those onboard ERS-1 acquire radar image data in all weather conditions and at night. Data for four of the 15 images have been processed to determine ice conditions on the rivers as detected by this satellite-borne SAR. Extensive databases of past ice conditions on these rivers, ground observations, ice thickness measurements and low-altitude aerial photographs collected during or within three days of ERS-1 overpasses were used to evaluate SAR image patterns resulting from the river ice on the four images. The preliminary results of these evaluations suggest that satellite-borne SARs will provide data on river ice conditions that are necessary for navigating through ice and for evaluating the potential for river ice jams and ice erosion along shorelines.

MP 3395

FMCW RADAR INVESTIGATION OF SNOW PACK EVOLUTION.

Koh, G., *Eastern Snow Conference and Western Snow Conference. Proceedings*, 1993, Joint 50th and 61st, p.123-127, 6 refs.

48-2936

SNOW SURVEYS, SNOW STRATIGRAPHY, METAMORPHISM (SNOW), SNOW HYDROLOGY, SUBSURFACE INVESTIGATIONS, RADIO ECHO SOUNDINGS, BACK-SCATTERING

Numerous snow pack evolution models have been developed to predict the physical properties of a snow pack as a function of past and present weather conditions. In order to evaluate the effectiveness of these models, continuous and noninvasive techniques are required to monitor the properties of a snow pack over an extended time. The temporal resolution of these techniques must be adequate to respond to the changes in snow pack properties under rapidly varying weather conditions. The most promising noninvasive technique for monitoring snow pack properties may be the frequency-modulated continuous wave (FMCW) radar. Time series radar backscatter measurements obtained with an FMCW radar (26.5 to 40 GHz) are presented and compared with the environmental conditions and the snow properties. The capabilities and limitations of an FMCW radar for snow pack studies are highlighted.

MP 3396

SNOWDRIFT MODELING IN THE CRREL WIND TUNNEL.

Haehnel, R.B., Wilkinson, J.H., Lever, J.H., *Eastern Snow Conference and Western Snow Conference. Proceedings*, 1993, Joint 50th and 61st, p.139-147, 24 refs.

48-2938

SNOWDRIFTS, BLOWING SNOW, SNOW AIR INTERFACE, SNOW FENCES, SNOW EROSION, WIND EROSION, WIND TUNNELS, ENVIRONMENTAL TESTS, MATHEMATICAL MODELS

The authors modified CRREL's Snow Drifting Wind Tunnel to generate a flow field that simulates the atmospheric boundary layer, and installed a trap for measuring the average mass flux. They replaced the previously used activated clay with glass beads and developed a moiré photography system to measure drift profile. A series of preliminary calibration tests were conducted to verify the similarity of model and full-scale snowdrifts. Two-dimensional calibrations included a Wyoming snow fence and a step. Three-dimensional tests included a right circular cylinder and a rectangular prism. Generally, the agreement was good between model and prototype drift geometries. However, there is insufficient quantitative field data available to thoroughly validate the model results.

MP 3397

PERMEABILITY OF TEMPERATE SNOW: PRELIMINARY LINKS TO MICROSTRUCTURE.

Hardy, J.P., Albert, D.G., *Eastern Snow Conference and Western Snow Conference. Proceedings*, 1993, Joint 50th and 61st, p.149-156, 16 refs.

48-2939

SNOW PERMEABILITY, SNOW AIR INTERFACE, SNOW HYDROLOGY, SNOW CRYSTAL STRUCTURE, SNOW DENSITY, MICROSTRUCTURE, STATISTICAL ANALYSIS

The intrinsic permeability of snow is an important parameter controlling meltwater flux through a snowpack and snowpack ventilation. Few measurements have been made on the permeability of seasonal snow covers, particularly in temperate zones where ice layers have an important control on the permeability. The purpose of this research was to correlate field measurements of permeability with physical properties of the snow. Throughout the 1992-93 winter season, field measurements were made using an air permeameter to determine the permeability of different snow types in northern Vermont. Concurrent with the permeability measurements, the physical properties of each stratigraphic layer were measured and samples for microstructural analysis were collected. Permeability values ranged from 3 to $75 \times 10^{-10} \text{ m}^2$ and agreed with previously published data. No correlation was found between field-measured physical properties and snow permeability. Stereologic parameters for dry snow correlated well with permeability, but for old snow, especially ice layers, the correlation was poor.

MP 3398

ESTIMATING TOTAL SNOW VOLUME IN A SMALL ALPINE WATERSHED USING REMOTELY SENSED DATA AND GROUND-BASED SURVEYS.

Davis, R.E., Elder, K., Rosenthal, W., Melack, J.M., Sickman, J., *Eastern Snow Conference and Western Snow Conference. Proceedings*, 1993, Joint 50th and 61st, p.197-203, 12 refs.

48-2945

SNOW SURVEYS, SNOW WATER EQUIVALENT, SNOW COVER DISTRIBUTION, SNOW DEPTH, RUNOFF FORECASTING, STREAM FLOW, SPACEBORNE PHOTOGRAPHY, LANDSAT

Ground surveys of snow water equivalence and snow cover maps derived from Landsat TM imagery provided the basis for investigating different methods to estimate total snow volume in a small watershed of the eastern Sierra Nevada of California. Snow density profiles and Federal Snow Sampler observations along ground transects made up the measurements used to estimate the snow water equivalence at several points. The area of the snow cover was estimated with two techniques, a supervised classification and a method based on spectral mixture modeling. Total snow volume was obtained by distributing snow water equivalence over the snow-covered area with the help of a digital elevation model. Snow volume estimates, in terms of their water equivalence, were compared with the estimated total snowmelt runoff. Total snowmelt runoff was estimated by subtracting baseflow as determined with a graphical technique. The comparisons were evaluated in the context of potentially combining remote sensing data with traditional snow course measurements to determine total snow cover volume.

MP 3399

SNOWPACK STRATIGRAPHY EVOLUTION AT FORESTED AND OPEN SITES.

Albert, M.R., Hardy, J.P., *Eastern Snow Conference and Western Snow Conference. Proceedings*, 1993, Joint 50th and 61st, p.205-212, 10 refs.

48-2946

SNOW SURVEYS, SNOW STRATIGRAPHY, METAMORPHISM (SNOW), SNOW HYDROLOGY, SNOW MELTING, SNOW HEAT FLUX, VEGETATION FACTORS

Field observations of seasonal snowpack stratigraphy evolution over the course of a winter are described at open and deciduous forest sites. The predominant stratigraphic features of the two sites were similar, although the snow sometimes had dramatically different behavior in response to tree- and slope-induced local meteorologic differences. Differences in solar radiation between the two sites produced differences in the early snowcover, which then controlled the formation and nature of the basal ice layer that remained throughout the season. At this location, the greater longwave radiation induced by the trees at the forested south-facing hillside offset the greater solar radiation at the open site, so that net allwave radiation at the two sites was approximately equal. More snowpack mass was lost during snowmelt at the forested hillside than at the open site because the melt generated in the upper half of the pack flowed laterally through the pack in the downslope direction. At the open site, snowmelt at the surface flowed vertically through the pack, sometimes adding mass to lower layers. In addition, field observations illustrate that capillary effects produce observable changes in snowpack layering, and need to be included in modelling of metamorphic snowmelt processes.

MP 3400

EXAMINING THE INFLUENCE OF SNOW COVER ON MORNING AIR TEMPERATURE.

Hogan, A.W., Ferrick, M.G., *Eastern Snow Conference and Western Snow Conference. Proceedings*, 1993, Joint 50th and 61st, p.223-229, 19 refs.

48-2948

SNOW COVER EFFECT, SNOW AIR INTERFACE, AIR TEMPERATURE, SURFACE TEMPERATURE, DIURNAL VARIATIONS

There are large differences in mean minimum winter air temperature among very proximate New England stations. Daily differences are even greater when research sites are compared. The authors conducted a series of experiments, in morning twilight during the winter months, to examine the influence of topography and snow cover on early morning air temperature. The hypothesis is proposed that the impounding of the Connecticut River extending above the Wilder dam provides a temperature reference plane, allowing evaluation of physical factors modifying air temperatures adjacent to the reference plane. Analyses of surface air temperature with respect to elevation and distance along the Connecticut River valley show consistent vertical temperature structures that are related to snow cover. The authors present analyses of temperature structure and the relation of surface air temperature to vertical temperature structure in the vicinity of the reference plane.

MP 3401

AEROSOL SCAVENGING BY FALLING SNOW.

Cragin, J.H., Hewitt, A.D., *Eastern Snow Conference and Western Snow Conference. Proceedings*, 1993,

Joint 50th and 61st, p.307-314, 19 refs.

48-2958

FALLING SNOW, SNOW CRYSTAL STRUCTURE, SNOW-FLAKES, SCAVENGING, AEROSOLS, SMOKE GENERATORS, VISIBILITY

Removal of atmospheric aerosols by falling snowflakes was studied during several winters in Hanover, NH, using micron-sized particles. Experiments were performed in open air and within static and dynamic aerosol chambers. The primary scavenging mechanism for particles in this size range was inertial impaction. Scavenging efficiencies were determined by collecting and chemically analyzing snowflakes that were allowed to fall naturally through the static chamber containing a cloud of known aerosol concentration. The average scavenging efficiency (defined as the ratio of the mass of aerosol collected by the snowflake to the total mass of aerosol in the swept volume) of several different types of snowflakes and ice crystals was 0.11 ± 0.08 . Higher scavenging efficiencies were observed for three-dimensional spatial dendrites than for planar crystals, such as planar dendrites and hexagonal plates. Overall, snow was found to be four to five times more efficient than rain in scavenging 0.3-6 micron-sized particles. Laser attenuation measurements in a dynamic aerosol chamber indicated that particle scavenging can cause relative transmission increases of as much as 15% for each minute of exposure to snowfall. Model calculations predicted aerosol cloud half-lives of 2 to 20 minutes for snow precipitation rates of 2.5 to 0.5 cm/hr.

MP 3402

STRESS ANALYSIS OF A PROPOSED TUNNEL UNDER THE SOUTH POLE SKIWAY.

Sodhi, D.S., Rand, J.H., Tobiasson, W., *Eastern Snow Conference and Western Snow Conference. Proceedings*, 1993, Joint 50th and 61st, p.347-354, 8 refs.

48-2963

SNOW TUNNELS, SNOW STRENGTH, SNOW COMPRESSION, ICE RUNWAYS, ENVIRONMENTAL TESTS, BEARING TESTS, ANTARCTICA—AMUNDSEN-SCOTT STATION

Unlined tunnels in the snow at South Pole Station will be used for safe movement of personnel to satellite science buildings during the austral winter. The first 1.8 m (6 ft) wide, 3 m (10 ft) high tunnel will pass under the existing skiway. This study determined the depth at which that tunnel should be located to be safe when aircraft pass over it. Three efforts were undertaken: (a) conducting a three-dimensional elastic stress analysis of the snow around the tunnel, (b) comparing the maximum tensile and shear stresses from that analysis with corresponding strengths published in the literature, and (c) performing two experiments at South Pole to determine the surface pressure required to fail the snow around model tunnels. The authors found general agreement of theoretical and experimental results and recommended that the roof of the tunnel be located at least 6.1 m (20 ft) below the surface of the skiway. (Auth. mod.)

MP 3403

MESOSCALE ATMOSPHERE ICING EVENT, MARCH 1991.

Bates, R.E., Fiori, J.E., Fisk, D.J., Harrington, B.G., *Eastern Snow Conference and Western Snow Conference. Proceedings*, 1993, Joint 50th and 61st, p.355-364, 3 refs.

48-2964

ICE STORMS, GLAZE, ICE ACCRETION, SYNOPTIC METEOROLOGY, METEOROLOGICAL DATA, WEATHER OBSERVATIONS, UNITED STATES—NEW YORK

During a field experiment designed to characterize winter atmospheric meteorological conditions and the physical properties of the snow cover backgrounds at Ft. Drum, NY, a severe atmospheric icing/glaze event occurred. This icing event was documented with an automatic meteorological recording station located near the center of the storm track. The measurement recording interval was set at a frequency of 10 minutes, and three days of icing precipitation and glaze formation data were measured. Over the three days, varying intensities and/or combinations of freezing rain and drizzle, rain, snow, ice pellets and fog occurred at the measurement site. The synoptic situation during this event included a low pressure center, with supporting cold and warm fronts that combined as an occluded front over central New York State. This front stalled and the resulting mixture of cold and warm air masses included nearly all types of high intensity frozen precipitation. This moisture when precipitating out of the cloud formation resulted in up to 1 in (2.5 cm) of ice accretion and glaze formation on all exposed objects over a wide geographical area.

MP 3404

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON OFFSHORE MECHANICS AND ARCTIC ENGINEERING, 1994. VOLUME 4: ARCTIC/POLAR TECHNOLOGY.

International Conference on Offshore Mechanics and Arctic Engineering, 13th, Houston, Texas, Feb. 27-Mar. 3, 1994, Nixon, W.A., ed, Sodhi, D.S., ed, Sinha, N.K., ed, Wang, A.T., ed, Ayorinde, O.A., ed, New York, American Society of Mechanical Engineering.

neers, 1994, 125p., Refs. passim. For selected papers see 48-3013 through 48-3029.

48-3012

ICE MODELS, ICE ADHESION, ICE STRENGTH, ICE LOADS, ICE DEFORMATION, ICE SOLID INTERFACE, ICE PRESSURE, OFFSHORE STRUCTURES, SEA ICE, DESIGN

MP 3405

THEORETICAL MODEL FOR ICE-STRUCTURE INTERACTION.

Sodhi, D.S., International Conference on Offshore Mechanics and Arctic Engineering, 13th, Houston, Texas, Feb. 27-Mar. 3, 1994. Proceedings. Edited by W.A. Nixon, D.S. Sodhi, N.K. Sinha, A.T. Wang, and O.A. Ayorinde, New York, American Society of Mechanical Engineers, 1994, p.29-34, 17 refs.

48-3017

ICE MODELS, ICE SOLID INTERFACE, ICE PRESSURE, MATHEMATICAL MODELS

A theoretical model to simulate ice-structure interaction during intermittent crushing is developed on the basis of experimental results from indentation tests, conducted by pushing vertical flat indentors into the edges of freshwater floating ice sheets. The equations and solutions of each phase of interaction are presented. Besides simulating the interaction during intermittent crushing, the model is able to simulate the interaction during continuous brittle crushing at high rates of indentation. A few results from the interaction model are presented to show the effect of different factors on the frequency of intermittent crushing and on the velocity at which transition from intermittent to continuous crushing takes place.

MP 3406

OBSERVATIONS ON MACHINE-MADE SNOW AS A MILLIMETER-WAVE OBSCURANT.

Yankielun, N.E., Koh, G., Bates, R.E., Perron, F.E., Smoke/Obscurants Symposium, 17th, Laurel, MD, Apr. 13-16, 1993. Proceedings. Vol.1, U.S. Army Edgewood Research, Development and Engineering Center, Aberdeen Proving Ground, MD, 1993, p.19-29, 8 refs.

48-3031

SNOW MANUFACTURING, ARTIFICIAL SNOW, BLOWING SNOW, SNOW ELECTRICAL PROPERTIES, ATTENUATION, MICROWAVES, MILITARY OPERATION

Water-based screeners have the potential to be an effective, economical, environmentally benign and easily deployable obscurant for defeating weapon systems employing microwave and millimeter-wave sensors. In a winter environment, it may be possible to utilize machine-made snow as a millimeter-wave obscurant, since vast amounts of airborne snow can be easily generated and disseminated throughout an operational area. The effectiveness of the machine-made snow will depend on the airborne mass concentration, particle size, and the unfrozen water content of the generated snow screen. To evaluate the potential application of machine-made snow as a millimeter-wave obscurant, experiments were conducted to observe the attenuation levels attainable at 26.5 to 40 GHz. Observations on the effectiveness were made at a variety of midwinter air temperatures and humidity levels. The preliminary experimental results are presented.

MP 3407

MODIFICATION OF PHYSICAL PROPERTIES OF NATURAL OBSCURANTS.

Hogan, A.W., Smoke/Obscurants Symposium, 17th, Laurel, MD, Apr. 13-16, 1993. Proceedings. Vol.1, U.S. Army Edgewood Research, Development and Engineering Center, Aberdeen Proving Ground, MD, 1993, p.213-217, 10 refs.

48-3032

AEROSOLS, COAGULATION, PARTICLE SIZE DISTRIBUTION, ATMOSPHERIC COMPOSITION, AIR POLLUTION

There are many theories that relate the change in surface properties of naturally occurring aerosols to chemical reactions at the particle surface. It is also possible to modify the surface properties of the aerosol through interaction among particles of differing properties within the aerosol. This modification can be rapid when the aerosol concentration is relatively great and its components substantially differ. A model has been assembled to generalize the Fuchs multicomponent aerosol coagulation theory, which uses particle number conservation rather than particle volume conservation to provide continuity. This allows the model to provide accounting of the amount of particle surface covered by smaller particles through the coagulation process. Algorithms are included in the model which allow the model calculations to be performed at any selected tropospheric level or temperature. The model allows two aerosols to be mixed and calculates the evolving size and surface property distribution of the resulting aerosol as a function of time. A parallel calculation program within the model provides the rate of modification of aerosol surface by introduced particles. Results of computations, giving rates of modification of the surface properties of soot by photochemically generated particles, and of insoluble particles by water clusters, are given.

MP 3408

DESIGN AND EVALUATION OF A TOWED SNOW PLOW FOR THE SMALL UNIT SUPPORT VEHICLE (SUSV).

Richmond, P.W., Walsh, M.R., Subzero Engineering Conditions Conference, Brainerd, MN, Feb. 21-24, 1994. Proceedings, Warrendale, PA, Society of Automotive Engineers, Inc., 1994, p.89-94, 3 refs.

48-3095

SNOW VEHICLES, SNOW REMOVAL, TRACKED VEHICLES, MILITARY EQUIPMENT, MILITARY OPERATION Light Infantry Divisions must conduct semiautonomous operations and limited self-resupply in remote snow-covered areas. Most wheeled vehicles become immobilized once the vehicle sinkage is greater than its ground clearance. Since many roads and trails will not have been kept open prior to deployment, truck-mounted plows will be ineffective for clearing snow. In most instances, heavy tracked vehicles, which may not be available, are required to plow snow. Therefore a snow removal method using vehicles readily available to light forces is needed. The US Army's Small Unit Support Vehicle (SUSV) is a lightweight, low-ground-pressure tracked vehicle. A towed V-type plow assembly was proposed for this vehicle. A four-bar parallel linkage towing assembly was developed that bolts directly on to the SUSV's pintle hook mounting bracket. The plow was constructed primarily of aluminum, has three plowing widths, and can be towed over a road on integral wheels. This paper describes the design and operation of the plow, along with results of field tests conducted in Alaska, where the SUSV successfully towed the plow through 85 cm of unbonded snow.

MP 3409

THREE APPROACHES TO WINTER TRACTION TESTING USING INSTRUMENTED VEHICLES.

Shoop, S.A., Young, B., Alger, R., Davis, J., Subzero Engineering Conditions Conference, Brainerd, MN, Feb. 21-24, 1994. Proceedings, Warrendale, PA, Society of Automotive Engineers, Inc., 1994, p.165-171, 12 refs.

48-3105

ROAD ICING, TRACTION, MOTOR VEHICLES, TIRES, RUBBER SNOW FRICTION, RUNWAYS, ENVIRONMENTAL TESTS, COLD WEATHER TESTS, TEST EQUIPMENT Traction on winter surfaces was measured using three test vehicles, each designed to measure traction for a different purpose: vehicle mobility research (CRREL instrumented vehicle), commercial tire testing (Uniroyal-Goodrich traction tester), and airport runway safety (SAAB friction tester). The tractions measured with each method are comparable, but there are systematic differences due to the effects of the surface materials and the test and analysis techniques. This comparison serves as a basis for collaboration among the various traction and data analyses for traction testing and evaluation.

MP 3410

DEVELOPMENT OF A PORTABLE ICE-THICKNESS MEASURING INSTRUMENT.

Joseph, J.C., Glynn, D.P., Joseph, P.J., Chester, NH, Dedicated Electronics, Inc., 1994, 17p., Sponsored by U.S. Army Cold Regions Research and Engineering Laboratory under Contract No.DACA33-91-C-0030.

48-3118

ICE SURVEYS, ICE COVER THICKNESS, ICE ELECTRICAL PROPERTIES, ICE WATER INTERFACE, THICKNESS GAGES, PORTABLE EQUIPMENT, MICROWAVES

A portable instrument that can be manually placed in contact with the surface of an ice-covered body of water to non-obtrusively measure the ice thickness was developed. The instrument design is based on determining ice thickness from microwave frequency signals which are transmitted through the ice and reflect from the ice/water interface. Prior methods include drilling through the ice to manually measure its thickness, and using radar equipment which is costly, time consuming, and which produces data often difficult to interpret. The ice measuring instrument produced under this contract meets its goals for performance and physical characteristics. Measurement range exceeds the required 2 to 24 inches with 1/2 inch accuracy. Ice measurements take 12 seconds on average, thickness processing takes 10 seconds, and calibration is performed in under 30 seconds. The instrument is fully portable; it is powered by an internal rechargeable battery. The instrument is built into a transit case which also houses all accessories. Overall dimensions are 20 x 14 1/2 x 15 inches (LxWxH). Weight is 30 1/2 lbs. Performance has been verified by measurement of ice 2 to 24 inches thick and by measurement of sheets of polyethylene 2 to 32 inches thick.

MP 3411

LIGHT REFLECTION FROM SEA ICE DURING THE ONSET OF MELT.

Perovich, D.K., *Journal of geophysical research*, Feb. 15, 1994, 99(C2), p.3351-3359, 25 refs.

48-3197

SEA ICE, OPTICAL PROPERTIES, REMOTE SENSING,

ICE OPTICS, ICE MELTING, RADIOMETRY, ALBEDO, RADIANCE, REFLECTIVITY, POLARIZATION (WAVES), SNOW COVER EFFECT

Spectral measurements of albedo, bidirectional reflectance distribution function, and polarized reflectance were made for arctic sea ice conditions found during the onset of melt. The wavelength region studied was from the visible to the near infrared (400-1000 nm). Results are presented for the five following surface types: (1) dry snow, (2) dry snow with a glazed surface, (3) bare ice, (4) blue ice, and (5) melt pond. Results indicate that spectral albedos decrease at all wavelengths as the melt season progresses and the surface conditions evolve from (1) through (5), and that the decrease is most pronounced at longer wavelengths. Reflectance data suggest that at most angles, reflectance has the same spectral shape as albedo. Light reflected at 60 deg zenith angle was strongly polarized. In general, light reflected from snow-free ice was more strongly polarized, with the degree of polarization increasing with wavelength.

MP 3412

UPTAKE AND LOSS OF WHITE PHOSPHORUS IN AMERICAN KESTRELS.

Nam, S.I., Roebuck, B.D., Walsh, M.E., *Environmental toxicology and chemistry*, 1994, 13(4), p.637-641, 24 refs.

48-3222

EXPLOSIVES, SOIL POLLUTION, MILITARY RESEARCH, ENVIRONMENTAL TESTS, ECOSYSTEMS, ANIMALS, BIOMASS, CHEMICAL ANALYSIS, SIMULATION, UNITED STATES—ALASKA—EAGLE RIVER FLATS

In a test designed to examine the biotoxicological effects of white phosphorus, an ordnance component which is a common soil contaminant of artillery testing grounds, it was determined that American kestrels (*Falco sparverius*) exposed to a diet containing white phosphorus (P_4) had detectable quantities of P_4 only in their fatty tissues. As early as 24 h postdosage, P_4 was found in the fat depots and skin but not in other tissues such as the brain, heart, intestine, liver, kidney, and muscle. After 7 d of continuous exposure to P_4 -containing diet (6.4 micrograms P_4 per gram of diet), the skin but not fat depots showed significant accumulation of P_4 . When P_4 -containing diet (6.4 micrograms P_4 per gram of diet) was fed for 2 d followed by 3 d of feeding a diet containing less P_4 (0.7 microgram P_4 per gram of diet), P_4 was not detectable in the tissues. Upon refeeding with the higher dietary concentration of P_4 , P_4 was again detectable in skin and fat. This cyclic dosing regimen indicates that tissue levels are sensitive to dietary levels of P_4 .

MP 3413

VAPOR-FORTIFIED QA/QC SOIL SUBSAMPLES FOR THE ANALYSIS OF VOLATILE ORGANIC COMPOUNDS.

Hewitt, A.D., *American environmental laboratory*, 1994, No.3, p.1,6,7, 9 refs.

48-3266

SOIL POLLUTION, SOIL ANALYSIS, SOIL TESTS, SOIL CHEMISTRY

MP 3414

DYNAMIC TENSILE STRENGTH OF GLASS FIBER REINFORCED PULTRUDED COMPOSITES.

Dutta, P.K., Kumar, M.M., Hui, D., Materials and design technology. Edited by T.J. Kozik, New York, American Society of Mechanical Engineers, 1994, p.357-363, 6 refs.

48-3267

COMPOSITE MATERIALS, POLYMERS, LOW TEMPERATURE TESTS, TENSILE PROPERTIES

This paper discusses the stress-strain behavior, fracture strength, influence of low temperature, and energy absorption in the diametral tensile splitting fracturing of a glass fiber reinforced polymer composite. Experiments were conducted at low-temperature in a thermal chamber installed on a servo-hydraulic universal testing machine. The tensile strength was determined by diametral compression of disc samples at 24, -5 and -40 C.

MP 3415

APPLICATIONS OF RECYCLED PLASTICS FOR ROADSIDE SAFETY HARDWARE.

Dutta, P.K., McDevitt, C.F., Manikonda, S.G., Materials and design technology. Edited by T.J. Kozik, New York, American Society of Mechanical Engineers, 1994, p.345-349, 2 refs.

48-3268

ROAD MAINTENANCE, HIGHWAY PLANNING, SAFETY, PLASTICS, COMPOSITE MATERIALS, IMPACT TESTS

This paper summarizes the results of an investigation for possible designs of roadside safety hardware utilizing new composite materials made from recycled plastics and other reinforcing fibers. A candidate material made from a composite of wood fiber and recycled waste plastics was subjected to mechanical tests over a wide temperature range of 50 to -60 C. The results were encouraging enough to perform a demonstration field test in which an instrumented test vehicle impacted the guard rail posts made with the same material. The posts performed satisfactorily

to redirect the errant vehicle. Thus guard rail posts appear to be an important high volume application outlet for recycled plastics.

MP 3416
SCICEX-93: ARCTIC CRUISE OF THE U.S. NAVY NUCLEAR POWERED SUBMARINE USS PARGO.

Langseth, M., Tucker, W.B., *Marine Technology Society Journal*, Winter 1993-94, 27(4), p.4-12, 10 refs. 48-3269

SUBMARINES, SUBGLACIAL NAVIGATION, SUBGLACIAL OBSERVATIONS, ICE BOTTOM SURFACE, OCEANOGRAPHIC SURVEYS, NUCLEAR POWER

A nuclear powered submarine, USS *Pargo*, made a scientific cruise to the Arctic Ocean during the late summer of 1993. This was the first cruise of a nuclear submarine to the arctic in which the U.S. oceanographic community was openly invited to participate in the planning and implementation of the cruise. The data from the cruise will be placed in the public domain and results published in the open literature. During the cruise, called SCICEX-93, 9,080 km (4,900 nm) of underway data (bathymetry, gravity anomaly, temperature, salinity, ice draft, and images of the underside of the ice) were collected in the deep Arctic Ocean below the ice pack. Surface stations were occupied at 20 locations along the track. At these stations 35 CTD (conductivity, temperature, depth) casts were made in the shallow water of the Arctic Ocean (400-600 m), and 31 vertical current profiles were made using an expendable free-fall device. Bottle casts collected 1,500 water samples for chemical and biological analysis. While submerged, 31 submarine-launched expendable CTDs were deployed and 46 water samples were drawn through the submarine's seawater system. Four buoys were deployed in the ice; two were used for meteorological observations and two polar oceanographic profiling buoys were used to make long-term time-series measurements of temperature and salinity at 6 different depths in the shallow water of the Arctic Ocean. The SCICEX-93 cruise demonstrated the remarkable potential of nuclear powered submarines for oceanographic and geophysical studies of ice-covered regions of the ocean.

MP 3417
REINFORCING STEEL/CONCRETE BOND STRENGTH DEVELOPMENT IN CONCRETE CURED WITH ANTIFREEZE ADMIXTURE AT TEMPERATURES BELOW 0 DEG C.

Wood, T.B., Schroeder, H.P., International Cold Regions Engineering Specialty Conference, 7th, Edmonton, Alberta, Mar. 7-9, 1994. Proceedings. Edited by D.W. Smith and D.C. Sego. Cold regions engineering: "A global perspective", Montreal, Canadian Society for Civil Engineering, 1994, p.67-86, 8 refs. 48-3353

CONCRETE CURING, CONCRETE ADMIXTURES, CONCRETE STRENGTH, ANTIFREEZES, WINTER CONCRETING

It is estimated that the cost of protecting freshly placed concrete in the United States from freezing damage is approximately \$800 million annually. Chemical admixtures depress the freezing point of water and allow concrete to gain strength at temperatures which are below the freezing point of water. This study investigates the bond strength of the reinforcing steel and concrete in concrete cured at below-freezing temperature with an antifreeze admixture of sodium and calcium nitrate. Results indicate that concrete created with this antifreeze admixture and cured below 0 C will develop strengths comparable to concrete cured above 0 C without antifreeze admixtures.

MP 3418
STAGE-FREQUENCY OF HIGHLY VARIABLE ICE JAM EVENTS.

Zufelt, J.E., White, K.D., International Cold Regions Engineering Specialty Conference, 7th, Edmonton, Alberta, Mar. 7-9, 1994. Proceedings. Edited by D.W. Smith and D.C. Sego. Cold regions engineering: "A global perspective", Montreal, Canadian Society for Civil Engineering, 1994, p.165-174, 3 refs. 48-3359

ICE JAMS, FLOODS, FREEZEUP, ICE BOOMS, ICE MODELS, RIVER ICE, UNITED STATES—IDAHO—SALMON RIVER

Stage-frequency analyses are typically conducted to assess the effects of river improvements. Methods used to determine stage frequencies are based on either the historic records of actual stages experienced or stages synthesized from estimates of discharge frequency. Ice jam floods differ from open water events in that maximum or flood stages are often highly localized, resulting in ice effects being undetected by river stage gages outside the influence of the ice jam. The stages experienced during freezeup ice jams can also be highly variable from year to year. A method that calculates length frequency of freezeup ice jam events has proven to be especially useful for locations where ice jams may not occur every year.

MP 3419
EVALUATION OF PAVEMENT LAYER MODULI FOR AN INSULATED PAVEMENT USING

A THREE-DIMENSIONAL NON-LINEAR FINITE ELEMENT ANALYSIS.

Kestler, M.A., Stebbings, K., Berg, R.L., Zaghrou, S., White, T.D., International Cold Regions Engineering Specialty Conference, 7th, Edmonton, Alberta, Mar. 7-9, 1994. Proceedings. Edited by D.W. Smith and D.C. Sego. Cold regions engineering: "A global perspective", Montreal, Canadian Society for Civil Engineering, 1994, p.331-346, 16 refs. 48-3369

PAVEMENTS, DYNAMIC LOADS, FREEZE THAW CYCLES, COMPUTER PROGRAMS, ANALYSIS (MATHEMATICS)

A variety of methods exist for determining pavement layer moduli from Falling Weight Deflectometer (FWD) testing. The most common technique, back-calculation, assumes that FWD loading is static, and most back-calculation programs assume that the pavement materials exhibit linear elastic behavior. In contrast, ABAQUS, a three-dimensional finite element program, allows for the dynamic FWD loading and incorporates the nonlinear characteristics of the pavement materials. This more closely approximates the actual dynamic response and yields more realistic pavement layer moduli. Although reasonable matches between measured and back-calculated deflections can be obtained using conventional back-calculation techniques, corresponding insulating layer moduli can vary over many orders of magnitude. Recent studies using ABAQUS to estimate pavement layer moduli from FWD measurements and to determine dynamic response to moving loads for noninsulated pavements have been quite successful. This paper discusses the use of ABAQUS to estimate pavement layer moduli and dynamic response for an insulated pavement.

MP 3420
TRANS-ALASKA PIPELINE RESEARCH PROGRAM. PROGRESS REPORT 77-A.

Crory, F.E., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Nov. 1976, 18p. 48-3427

PIPELINES, PIPE LAYING, COLD WEATHER CONSTRUCTION, PERMAFROST BENEATH STRUCTURES, ENVIRONMENTAL IMPACT, UNITED STATES—ALASKA

MP 3421
TRANS-ALASKA PIPELINE RESEARCH PROGRAM. PROGRESS REPORT 77-B.

Austin, M.A., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, July 1977, 18p. 48-3428

PIPELINES, PIPE LAYING, COLD WEATHER CONSTRUCTION, PERMAFROST BENEATH STRUCTURES, ENVIRONMENTAL IMPACT, UNITED STATES—ALASKA

MP 3422
USE OF AN INFRARED SCANNER AND A NUCLEAR METER TO FIND WET INSULATION IN A BALLASTED ROOF.

Tobiasson, W., Greated, A., *SPIE—The International Society for Optical Engineering. Proceedings*, 1994, Vol.2245, Thermosense XVI: an international conference on thermal sensing and imaging diagnostic applications, Orlando, FL, Apr. 6-8, 1994, p.52-61, 5 refs. 48-3413

ROOFS, THERMAL INSULATION, MOISTURE DETECTION, MOISTURE METERS, INFRARED PHOTOGRAPHY, RADIATION MEASURING INSTRUMENTS, COST ANALYSIS

An infrared scanner and a nuclear moisture meter were used to survey a ballasted roof suffering chronic leaks. Infrared surveys, conducted with the ballast in place, uncovered five small wet areas, some as small as this page. The thermal anomalies were faint and may have been missed during a routine infrared roof moisture survey. Nuclear readings were taken on a 1.5 m (5-ft) grid. High nuclear readings were obtained at the one grid point that fell within one of the five wet areas detected during the infrared survey. The other four wet areas were missed. However, the nuclear meter found an additional nine small wet areas that the infrared scanner missed. All but one of these areas contained wet urethane insulation directly below the membrane. In three other areas of the roof, nuclear readings were higher than those over the rest of the roof. Core samples verified that the perlite insulation at the base of the roof was wet in these areas, two of which were small, but one was 12 x 12 m (40 x 40 ft) when squared off. This "deep" moisture was not detected thermographically. On this roof infrared and nuclear surveys both provided valuable information but each missed a portion of the problem. When used in combination, their strengths were complementary.

MP 3423
INSTABILITY OF TETRYL TO SOXHLET EXTRACTION.

Jenkins, T.F., Walsh, M.E., *Journal of chromatogra-*

phy A, 1994, Vol.662, p.178-184, 24 refs. 48-3558

EXPLOSIVES, SOIL POLLUTION, SOIL TESTS, SAMPLING, CHEMICAL ANALYSIS, LABORATORY TECHNIQUES, ACCURACY

The stability of tetryl (N-methyl-N,2,4,6-tetranitroaniline) to Soxhlet extraction with methanol was examined by refluxing tetryl in methanol and extracting a tetryl-contaminated soil using Soxhlet, ultrasonic bath and wrist-action shaker methods. The results indicate that tetryl is unstable to Soxhlet extraction. If wet soils are Soxhlet-extracted with methanol, tetryl hydrolyzes to N-methylpicramide (N-methyl-2,4,6-trinitroaniline). If extracted dry, methanolysis products are formed. Ultrasonic bath extraction with acetonitrile is recommended instead.

MP 3424
TENSILE STRENGTH OF FIRST-YEAR SEA ICE.

Richter-Menge, J.A., Jones, K.F., *Journal of glaciology*, 1993, Vol.133(pt.3), p.609-618, 30 refs. 48-3587

SEA ICE, ICE STRENGTH, ICE CORES, TENSILE PROPERTIES, STRAIN TESTS, ICE SOLID INTERFACE, TEMPERATURE EFFECTS, BRINES, POROSITY, ICE MODELS, MATHEMATICAL MODELS

This paper presents the results of tests done to determine the tensile behavior of first-year columnar sea ice over a range of temperatures from -20 to -3 C and strain rates of 10^{-3} and $10^{-3}/s$. The temperature of a test specimen was dictated by its *in-situ* location within the sea-ice sheet; samples located near the top of the sea-ice sheet were tested at the lower temperatures. A tensile load was applied along the cylindrical axes of the test specimens, which were perpendicular to the growth direction of the ice. Results showed that the maximum stress reached during a test was most strongly influenced by temperature, while the failure strain and the modulus were principally affected by the loading rate. A model relating the tensile strength of the ice to its porosity based on temperature-dependent variations in the brine-pocket geometry is evaluated. (Auth.)

MP 3425
END-CAPPING PROCEDURE FOR CORED ICE SAMPLES USED IN TENSION TESTS.

Richter-Menge, J.A., Claffey, K.J., Walsh, M.R., *Journal of glaciology*, 1993, Vol.133(pt.3), p.698-700, 13 refs. 48-3596

SEA ICE, ICE STRENGTH, TENSILE PROPERTIES, ICE CORES, MECHANICAL TESTS, ICE SOLID INTERFACE, LABORATORY TECHNIQUES, ACCURACY

This note describes an end-capping procedure used to prepare cylindrical ice-core samples for direct tension testing. The techniques developed build on work done by Cole and others (1985) and Lee (1986), and include a design modification to the loading train and a more reliable approach to establishing the fresh-water bond used to mount the end caps on the sample. With these techniques, an 88% success rate was achieved in a recent series of uniaxial tension tests.

MP 3426
DYEING OF SNOW SURFACES TO OBSERVE SNOW STRUCTURE.

Kovacs, A., *Journal of glaciology*, 1993, Vol.133(pt.3), p.709-711, 4 refs. 48-3601

SNOW STRATIGRAPHY, SNOW COVER STRUCTURE, COLORED SNOW, SOLUTIONS, TESTS, LABORATORY TECHNIQUES

MP 3427
SEA-ICE INVESTIGATIONS ON NATHANIEL B. PALMER: CRUISE 92-2.

Ackley, S.F., Gow, A.J., Lytle, V.I., Yankielun, N.E., Darling, M.N., *Antarctic journal of the United States*, 1992, 27(5), p.87-88, 9 refs. 48-3770

SHIPS, RESEARCH PROJECTS, SEA ICE, ICE PHYSICS, VARIATIONS, SNOW PHYSICS, SNOW SURFACE, SNOW ICE INTERFACE, ANTARCTICA—WEDDELL SEA Preliminary results of studies made on sea ice in the western Weddell Sea in May and June of 1992 aboard the vessel *Nathaniel B. Palmer* are presented. The principal objective was to obtain some regional depiction of the ice properties and processes over several scales, from microstructural properties to the variability of ice types, over the length of the track. The vessel stopped for a total of 14 full ice stations and 1 coring station. A complete ice station consisted of the collection of four cores; snow-pit studies in which physical property measurements were made of the snow; snow surface elevation surveys; and radar backscatter investigations of snow thickness and snow/ice interface characteristics.

MP 3428
ICE-CORE STUDIES IN THE WESTERN WEDDELL SEA (NATHANIEL B. PALMER 92-2).

Gow, A.J., Ackley, S.F., Lytle, V.I., Bell, D., *Antarctic journal of the United States*, 1992, 27(5), p.89-

90, 4 refs.

48-3771

SEA ICE, ICE PHYSICS, ICE COVER THICKNESS, YOUNG ICE, ANTARCTICA—WEDDELL SEA

In this report the authors give examples of the physical properties of the ice cores obtained in the western Weddell Sea and compare them to previous work in the area. Ice stations were occupied while transiting from the ice edge to the Ice Station Weddell 1 and during the return trip to the ice edge (May 21 to June 22, 1992). A total of 15 stations were made, including two stations where first-year lead ice was sampled in addition to the thicker ice next to the ship. A plot of bulk salinities versus ice thickness at the 15 sampling sites is shown. In general, the salinities are highest in the thinner ice types. On the basis of observations made, three main kinds of ice were encountered: young ice (less than 60 cm thick) that had formed during the current winter season; ice that had formed in the 1991 winter and had survived the 1991-1992 summer; and older, thicker ice that had persisted through two separate winters and was entering a third winter.

MP 3429

ICE OBSERVATIONS IN THE WESTERN WEDDELL SEA (NATHANIEL B. PALMER 92-2).

Darling, M.N., Lytle, V.I., Ackley, S.F., *Antarctic journal of the United States*, 1992, 27(5), p.91-93, 5 refs.

48-3772

SEA ICE DISTRIBUTION, ICE CONDITIONS, RESEARCH PROJECTS, DATA PROCESSING, ANTARCTICA—WEDDELL SEA

During May-June 1992, the *Nathaniel B. Palmer* made 4 traverses of the western Weddell Sea in conjunction with operations on Ice Station Weddell 1. The method of recording observations was consistent throughout the project. An observer noted the ship position and surrounding ice conditions every hour using a numerical scheme. Categories noted were: total ice concentration, percent concentration of ice types, floe size, topography, snow type, and open water characteristics. Ice thickness and snow thickness were also estimated. These observations differ from those made during the U.S.-U.S.S.R. Weddell Polynya expedition in 1981 in which the pack-ice zone was divided into 3 distinct regions delineated by wave action and swell propagation. Although the outbound leg of the rotation cruise passed through four distinct regions, they differed from those observed in 1981 in terms of both observed characteristics and the processes by which they were formed.

MP 3430

SNOW PROPERTIES AND SURFACE-ELEVATION PROFILES IN THE WESTERN WEDDELL SEA, (NATHANIEL B. PALMER 92-2).

Lytle, V.I., Ackley, S.F., *Antarctic journal of the United States*, 1992, 27(5), p.93-94, 10 refs.

48-3773

SEA ICE, SNOW DEPTH, SNOW PHYSICS, ICE COVER THICKNESS, ICE CORES, RESEARCH PROJECTS, ANTARCTICA—WEDDELL SEA

During the Weddell Sea Cruise of the *Nathaniel B. Palmer* in May and June 1992, 15 ice stations were occupied. At most of these stations ice cores were collected, surface snow and ice elevation lines were measured, and snow characterization was performed. Two 100 m surface elevation lines at each station were measured. They were positioned at right angles to each other; measurements of the snow thickness, and the ice and snow elevations above sea level were collected at 0.5 m spacing. In addition, ice thickness holes were drilled and measured along these same lines at about 10 m spacing. A total of 22 surface elevation lines were measured. These measurements, which were taken during the austral winter, did not in general show the significant below-sea-level portions that were seen both on the Ice Station during this year's austral fall and in data taken in austral spring.

MP 3431

MILLIMETER-WAVE RADAR BACKSCATTER MEASUREMENTS OVER WEDDELL SEA PACK-ICE (NATHANIEL B. PALMER 92-2).

Yankielun, N.E., Ackley, S.F., *Antarctic journal of the United States*, 1992, 27(5), p.95-96, 3 refs.

48-3774

RESEARCH PROJECTS, RADAR, SEA ICE, PACK ICE, ICE SURFACE, SNOW SURFACE, ICE PHYSICS, SNOW PHYSICS, ANTARCTICA—WEDDELL SEA

The research vessel *R/V Nathaniel B. Palmer* traversed the Weddell Sea during May and June 1992. At 15 ice stations along the route, a Ka band (35 GHz) radar was used to measure backscatter from the snowcover and underlying sea-ice surface. The authors' objective is to understand the interaction of electromagnetic radiation with the snow and sea ice in this region for better interpretation of geophysical parameters from aircraft, spaceborne radars, and radiometers at microwave frequencies. Detailed snow and ice physical property observations were performed, including characterization of snow and ice surface roughness, salinity, density, grain size, and snow stratigraphy.

MP 3432

SEA-ICE INVESTIGATIONS ON ICE STATION WEDDELL 1: II. ICE THERMODYNAMICS.

Ackley, S.F., Lytle, V.I., *Antarctic journal of the United States*, 1992, 27(5), p.109-110, 6 refs.

48-3777

SEA ICE, ICE GROWTH, ICE AIR INTERFACE, ICE COVER THICKNESS, ICE DEFORMATION, AIR TEMPERATURE, SNOW TEMPERATURE, SNOW DEPTH, ANTARCTICA—WEDDELL SEA

The objective of the thermodynamics measurement program was to identify mass balance of the sea ice over the western Weddell Sea. The authors measured the net ice growth or decay in the region of the ice station's drift and attempted to identify the individual or combination of processes responsible for those changes in the ice cover. Thermistor strings imbedded within the ice and snow covers were used to measure the heat flux between the ocean and atmosphere. Results indicate that top-surface ice growth is one of the major ice-growth processes for this region, because the old ice cover dominates the areal coverage and the thermistor data show little growth associated with bottom freezing processes in this ice.

MP 3433

SEA-ICE INVESTIGATIONS ON ICE STATION WEDDELL 1: I. ICE DYNAMICS.

Ackley, S.F., Elder, B., Lytle, V.I., Bell, D., *Antarctic journal of the United States*, 1992, 27(5), p.111-113, 7 refs.

48-3778

SEA ICE DISTRIBUTION, ICE COVER STRENGTH, ICE COVER THICKNESS, SHEAR STRESS, ICE DEFORMATION, ANTARCTICA—WEDDELL SEA

Several components of the sea-ice dynamics measurement program that was conducted on Ice Station Weddell 1 (ISW) from Feb. to June 1992 are reported. The objective of the dynamics measurement program was to identify how the sea-ice thickness distribution is affected by the deformational activity of the ice cover. Stress measurements within the ice cover relate the external forces to the deformational or rheological processes within the ice cover. Stress sensors, usually characterized as hard sensors because they are housed in a steel case of a high modulus of elasticity compared with the surrounding ice, were installed at 4 sites of differing ice type located at the camp floe. A preliminary look at the data, along with the visual field observations, generally shows that the stress field is highly episodic, with short bursts of high activity over minutes separated by hours or by days of little or no stress measured. Examples of the stress field resulting from several deformational processes were obtained, including tension cracking and rafting, buckling in thin ice, cracking resulting from pressure ridge edge loading, compressional ridge formation, and shear ridge formation in thicker ice.

MP 3434

ATMOSPHERIC SCIENCES ON ICE STATION WEDDELL.

Andreas, E.L., Claffey, K.J., Makshtas, A.P., Ivanov, B.V., *Antarctic journal of the United States*, 1992, 27(5), p.115-117, 4 refs.

48-3780

AIR ICE WATER INTERACTION, METEOROLOGICAL FACTORS, SNOW SURFACE TEMPERATURE, AIR TEMPERATURE, OCEANOGRAPHIC SURVEYS, ANTARCTICA—WEDDELL SEA

The broad objective of the joint U.S./Russian atmospheric sciences program on Ice Station Weddell was to understand air-ice-ocean interaction from measurements made on the air side of the interface. The core measurements of the program were made on the main meteorological tower. At a height of 5 m, small, fast-responding instruments measured the turbulent fluctuations in the 3 wind speed components, air temperature, and water vapor density. These measurements will yield the Reynolds fluxes of momentum (the surface stress) and sensible and latent heat. The authors supplemented these direct measurements of the turbulent fluxes with profile measurements on 2 nearby masts. A full suite of radiation measurements, consisting of incoming and outgoing shortwave and longwave radiation and the shortwave and longwave balances, complemented the turbulence measurements and completes the surface energy budget. Also measured was the snow-surface temperature with a Barnes PRT-5 infrared radiation thermometer and by a hygrometric technique. When a lead opened near the camp, 15 day observations of albedo, ice thickness and salinity, and radiative and physical temperatures of the surface and near-surface water, were carried out.

MP 3435

OBJECTIVE ESTIMATES OF AIRBORNE SNOW PROPERTIES.

Hogan, A.W., *Journal of atmospheric and oceanic technology*, Apr. 1994, 11(2)pt.2, p.432-444, 49 refs.

48-3784

SNOW PHYSICS, MEASUREMENT, FALLING SNOW, SNOWFLAKES, AEROSOLS, PHYSICAL PROPERTIES, SNOW CRYSTAL STRUCTURE, INDEXES (RATIOS), STATISTICAL ANALYSIS, ANALYSIS (MATHEMATICS)

A mensuration and description method is proposed that allows

objective and simultaneous expression of the physical properties of snow crystals, rimed drops, and aerosol particles. It is based on the statistics of Hatch and Choate, which are commonly used to describe "dusts" and supermicrometer aerosol particles with irregular shape. These statistics simplify integration of physical properties of snowflakes over their diameter distribution and facilitate expression of simultaneous formulas that can be used to calculate the contribution of riming to airborne snow mass and the contribution of rime nuclei to airborne snow chemistry. These formulated expressions are combined with tabulations of size properties of snowflakes, cloud droplets, and aerosol to provide the skeleton of a calculation program. Several figures are presented that show the variation of airborne snow area, mass contribution by rime, and snow chemistry as a function of crystal type and diameter distribution.

MP 3436

POLYGONAL PARTICLE SIMULATIONS OF SURFACE ICE FLOWS IN RIVER CHANNELS.

Babić, M., Hopkins, M.A., International Conference on Computational Methods in Water Resources, Denver, CO, June 1992. Proceedings, Vol.2. Edited by T.F. Russell et al, Southampton, UK, Computational Mechanics Publications, 1992, p.555-562, 7 refs.

48-3788

RIVER FLOW, RIVER ICE, DRIFT, ICE WATER INTER-FACE, ICE JAMS, ICE COVER EFFECT, HYDRODYNAMICS, PARTICLES, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION

A two-dimensional discrete element model for polygonal particles is developed and applied to the problem of surface ice flow in river channels. Ice particles are modeled as random convex polygons. Trajectories of a large number of individual particles are explicitly calculated. At each instant, all forces acting on each particle are determined. The equations of motion are then integrated to obtain updated positions and velocities of the particles. Hydrodynamic drag forces between particles and the fluid are included. The model is applied to a steady, decelerating flow in a straight river channel. An ice run entering the channel is retarded as it travels downstream. As a result, the ice concentration increases along the channel. Eventually, the densely packed ice forms a bridge spanning the channel, which can in turn initiate an ice jam nearby.

MP 3437

THAWING SOIL STRENGTH MEASUREMENTS FOR PREDICTING VEHICLE PERFORMANCE.

Shoop, S.A., *Journal of terramechanics*, Nov. 1993, 30(6), p.405-418, 12 refs. For another version see 44-3933.

48-3824

SOIL TESTS, VEHICLES, TRACTION, SOIL STRENGTH, UNFROZEN WATER CONTENT, GROUND THAWING, THAW DEPTH, THAW WEAKENING, SOIL TRAFFICABILITY, CORRELATION

The CRREL Instrumented Vehicle (CIV), shear annulus, direct shear and triaxial compression devices were used to characterize the strength of thawed and thawing soil. Strength was evaluated in terms of the Mohr-Coulomb failure parameters, which can be used in simple models to predict the tractive performance of vehicles. Use of an instrumented wheel (like those of the CIV) is proposed for terrain strength characterization for traction prediction because the conditions created by a tire slipping on a soil surface are exactly duplicated. The failure parameter values from a portable shear annulus overpredict traction because of the curved nature of the soil failure envelope in the region of low normal stress applied by a portable annulus. Of all the tests, the direct shear test yielded the highest internal angle of friction value, due to its slow deformation rate and drained conditions. The triaxial test produced results closest to those of the instrumented wheel. For all methods, internal angle of friction values increases with soil moisture but decreases rapidly beyond the liquid limit of the soil. The internal angle of friction value measured with the vehicle was also found to be strongly influenced by the freeze-thaw layering of the soil.

MP 3438

COMPARISON OF SOLID PHASE EXTRACTION WITH SALT-OUT SOLVENT EXTRACTION FOR PRECONCENTRATION OF NITROAROMATIC AND NITRAMINE EXPLOSIVES FROM WATER.

Jenkins, T.F., Miyares, P.H., Myers, K.F., McCormick, E.F., Strong, A.B., *Analytica chimica acta*, 1994, Vol.289, p.69-78, 22 refs. For another version see 47-3913.

48-3825

EXPLOSIVES, GROUND WATER, WATER POLLUTION, SAMPLING, CHEMICAL ANALYSIS, ENVIRONMENTAL TESTS, PERFORMANCE, CORRELATION

Residues of high explosives are a significant pollution problem at U.S. military facilities. Because TNT, RDX and HMX are mobile in the soil and have caused groundwater pollution, there is an increasing demand for low-concentration analysis of these compounds in water from installation boundary wells. Because RDX

and HMX are polar, conventional liquid-liquid extraction with nonpolar solvents yields poor recovery. Two techniques have been reported that appear to offer improved recovery and adequate preconcentration: solid phase extraction (SPE) and salting-out solvent extraction (SOE). This paper compares resin-based cartridge-SPE, membrane-SPE, and SOE using fortified reagent grade water samples and a set of 58 groundwater samples from an explosives-contaminated military facility. The three methods were comparable with respect to low-concentration detection capability, which ranged from 0.05 to 0.30 microg/l. Percent recoveries generally exceeded 80%, except for HMX and RDX by membrane-SPE. Interferences were found in extracts from half of the groundwater samples preconcentrated using the two SPE procedures, but were not found in any of the extracts from the SOE. These interferences were traced to matrix interaction of the polymeric resins with low-pH groundwater containing high levels of dissolved solids.

MP 3439

COMPARISON OF METHODS FOR SAMPLING VADOSE ZONE SOILS FOR DETERMINATION OF TRICHLOROETHYLENE.

Hewitt, A.D., *Journal of AOAC international*, 1994, 77(2), p.458-463, 7 refs.
48-3835

SOIL SCIENCE, SOIL TESTS, SOIL POLLUTION, SAMPLING, CHEMICAL COMPOSITION, LABORATORY TECHNIQUES, TEST EQUIPMENT, ACCURACY

This study compares 2 sampling and handling methods for the collection of soils to be analyzed for volatile organic compounds (VOCs). The currently accepted practice uses a vessel for the sole purpose of transferring and storing suspect soils from hazardous waste sites. This practice requires that the soil that is analyzed be handled at least twice: once when the vessel is filled on site and again when a subsample is removed for laboratory analysis. The sampling and handling protocol with which the current practice was compared limits sample exposure and disruption during collection and provides for sample acquisition during the field sampling exercise. The results confirm that sampling methods that limit disruption and exposure of soil samples are needed to obtain more accurate measurements of VOC concentrations in vadose zone soils.

MP 3440

VENTILATING ATTICS TO MINIMIZE ICINGS AT EAVES.

Tobiasson, W., Buska, J., Grotorex, A., International Conference on HVAC in Cold Climate, Rovaniemi, Finland, Mar. 15-18, 1994. Proceedings. Edited by J. Säteri and E. Kainlahti. Cold climate HVAC '94, Helsinki, FINVAC, Federation of Societies of Heating, Air-Conditioning and Sanitary Engineers in Finland, 1994, p.199-206, 6 refs.
48-3860

COLD WEATHER CONSTRUCTION, COLD WEATHER PERFORMANCE, BUILDINGS, ROOFS, ICING, ICE PREVENTION, VENTILATION, ICICLES

In cold regions, icicles and ice dams may develop on roofs that slope to cold eaves. Ventilating the space below the snow-covered roof with outdoor air to create a "cold" ventilated roof is often an effective way to avoid such problems. Several buildings in northern New York were instrumented to determine how their attic temperature influenced icing. The authors observed that problematic icings developed very slowly, if at all, when the outside temperature was above -5.5°C. Icings can be avoided by sizing natural, and if necessary, mechanical attic ventilation systems to maintain an attic temperature of -1°C when the outside temperature is -5.5°C.

MP 3441

INSTALLATION OF A PROTECTED MEMBRANE ROOF AT THE WINDIEST PLACE ON EARTH.

Tobiasson, W., Buska, J., International Conference on Development and Commercial Utilization of Technologies in Polar Regions, 5th, Luleå, Sweden, Mar. 22-25, 1994. Proceedings. Polartech '94, Luleå, University of Technology, 1994, p.196-207, 15 refs.
48-3962

BUILDINGS, ROOFS, THERMAL INSULATION, VAPOR BARRIERS, WATERPROOFING, WEATHERPROOFING, WIND PRESSURE, UNITED STATES—NEW HAMPSHIRE—WASHINGTON, MOUNT

In a protected membrane roofing system, insulation is placed above the membrane to keep the waterproofing layer out of harm's way. Ballast holds the extruded polystyrene insulation in place and protects it from the sun and traffic. Such a roof was installed several years ago for a building on the windy summit of Mt. Washington in New Hampshire. The loose-laid membrane leaked. Recently it was replaced with a fully-adhered protected membrane made with sheets of rubberized asphalt. The design rationale and installation of the new system at this wet, windy place are discussed. The installation was successful and the roofing system is performing well.

MP 3442

APPLYING FIELD-EXPEDIENT BIOREACTORS AND LANDFARMING IN ALASKAN CLIMATES.

Reynolds, C.M., Travis, M.D., Braley, W.A., Scholze, R.J., Hydrocarbon bioremediation. Edited by R.E. Hinchee et al, Boca Raton, FL, CRC Press, Inc., 1994, p.100-106, 8 refs.
48-4004

OIL SPILLS, SOIL POLLUTION, SOIL MICROBIOLOGY, SOIL CHEMISTRY, DECOMPOSITION, WASTE TREATMENT

Many contaminated soil sites in cold regions are isolated and remote. The authors have evaluated the feasibility of on-site treatment by using landfarming and field-expedient bioreactors, such as recirculating leachbeds. Landfarming can be used to treat the less-contaminated soil which often comprises the bulk of the contaminated soil volume. Highly contaminated soils can be readily contained and treated on site using recirculating leachbeds. In field evaluations, the spatial average of total petroleum hydrocarbon concentration in a diesel-contaminated soil decreased from 6,200 mg/kg dry soil to 280 mg/kg in approximately 7 weeks. Geostatistical techniques were used to delineate the spatial variability in total petroleum hydrocarbon concentration in the landfarm soil. Spatial variability decreased with time and yielded information that may provide guidance for cost-effective sampling. At another site, a recirculating leachbed was used to decrease TPH concentration in diesel-contaminated soil from between 300 mg/kg and 47,000 mg/kg to between 240 and 570 mg/kg in a 5-week period. The complementary use of these two technologies provides a cost-effective treatment option.

MP 3443

GENERAL CONSIDERATIONS FOR ROOFS.

Tobiasson, W., Moisture control in buildings. Edited by H.R. Trechsel, Philadelphia, PA, American Society for Testing and Materials (ASTM), 1994, p.291-320, 93 refs.
48-4008

BUILDINGS, ROOFS, WATERPROOFING, THERMAL INSULATION, VAPOR BARRIERS, VENTILATION, MOISTURE DETECTION

MP 3444

COMMENTS ON "ON THE CONTRIBUTION OF SPRAY DROPLETS TO EVAPORATION".

Andreas, E.L., *Boundary-layer meteorology*, 1994, Vol.68, p.207-214, 32 refs.
48-4023

MARINE METEOROLOGY, ATMOSPHERIC BOUNDARY LAYER, SEA SPRAY, HEAT FLUX, TURBULENT EXCHANGE, AEROSOLS, AIR WATER INTERACTIONS, ANALYSIS (MATHEMATICS)

Hasse (1992) used three distinct arguments to show that sea spray contributes negligibly to the air-sea fluxes of heat and moisture. He based these on (1) an energy constraint, (2) the surface area of the spray, and (3) the sea-salt aerosol in the marine atmosphere. On examining Hasse's arguments in turn, the present author will show, however, that each is seriously flawed. Sea spray cannot be discounted as an important agent for air-sea heat and moisture transfer.

MP 3445

SNOW AS AN EXPEDIENT SORBENT FOR HAZARDOUS MATERIALS.

Martel, C.J., Nadeau, B.M., *Journal of environmental science and health*, 1994, A29(1), p.237-247, 7 refs.
48-4155

ENVIRONMENTAL TESTS, COLD WEATHER TESTS, HYDROCARBONS, OIL SPILLS, OIL RECOVERY, SNOW IMPURITIES, SNOW PHYSICS, ABSORPTION, INDEXES (RATIOS), SNOW REMOVAL

Laboratory tests indicate that snow can be an effective sorbent for spills of insoluble hazardous materials. Fresh snow was found to be the most effective, followed by old snow and wet snow. The sorption ratios ranged from 0.24 g/g of snow to 3.12 g/g of snow depending on the type of snow and hazardous material. Although these sorption ratios are much lower than those for some commercial sorbents, adequate snow quantities for spill cleanup should be available at most snowcovered sites. Also, a column study indicated that much of the adsorbed liquid will drain out if soon after it is mixed with the snow. A hypothetical scenario is presented that shows how snow might be used as a sorbent in a typical spill.

MP 3446

TIME CONSTRAINTS ON MEASURING BUILDING R-VALUES.

Flanders, S.N., *Northern engineer*, 1979, 11(1), p.11-18, 18 refs. For another version see 35-1998.
48-4139

BUILDINGS, THERMAL INSULATION, HEAT FLUX, HEAT LOSS, THERMAL ANALYSIS, TEMPERATURE MEASUREMENT, ACCURACY, ANALYSIS (MATHEMATICS)

MP 3447

COMPRESSIVE FAILURE OF POLYCRYSTALLINE ICE UNDER IMPACT.

Dutta, P.K., International Offshore and Polar Engineering Conference, 3rd, Singapore, June 6-11, 1993. Proceedings. Vol.2. Edited by J.S. Chung, K. Karal, M.S. Triantafyllou, and R.W. Frederking, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1993, p.573-580, 27 refs.
48-4325

ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE DEFORMATION, ICE CRACKS, ICE SOLID INTERFACE, IMPACT TESTS, STRAIN TESTS, COMPRESSIVE PROPERTIES

Quasi-static tests have developed extensive data on the strain-rate effects in saline and fresh-water ice. The results suggest that at high rates, i.e., 10 to 10^3 s⁻¹, its uniaxial compressive strength is strain-rate independent. This investigation increases the compressive strain rate to still higher values (in the range of 10^3 to 10^5 s⁻¹) to determine if the compressive fracture stress continues to be strain-rate independent. Cylindrical specimens of polycrystalline ice were subjected to impact loading in a Hopkinson bar apparatus at about -16°C. The stress-strain behavior determined from the impact data shows multiple peaks, suggesting opening and closing of cracks before the catastrophic failure. The mechanism seems to confirm the recently developed frictional crack sliding/wing crack theory of brittle failure for ice. The compressive strength, defined as the peak stress, shows a slight dependence on the specimen size, but shows very little dependence on the strain rate.

MP 3448

CREEP AND FAILURE OF ICE UNDER MONOTONIC LOADING.

Fish, A.M., International Offshore and Polar Engineering Conference, 3rd, Singapore, June 6-11, 1993. Proceedings. Vol.2. Edited by J.S. Chung, K. Karal, M.S. Triantafyllou, and R.W. Frederking, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1993, p.613-618, 11 refs.
48-4332

ICE COVER STRENGTH, ICE DEFORMATION, ICE CREEP, ICE LOADS, ICE PRESSURE, STRAIN TESTS, MATHEMATICAL MODELS

Studies were carried out on deformation and failure of ice under monotonic loading. A constitutive equation, a strength criterion and a failure strain criterion were developed for ice under constant stress rate. The constitutive equation was developed by expansion of the modified primary creep model at constant stress over the monotonic loading regime. The strength criterion for monotonic loading was based upon the Robinson criterion for linear summation of microdefects. The equations of the model describe deformation and time-dependent failure of ice under monotonic loading at constant temperature by means of four rheological parameters. The model has been verified using published data from uniaxial compression tests of freshwater columnar-grained ice under various constant stress rates at -10°C. It is shown that the parameters of the model are interrelated and are in agreement with those obtained from previous creep tests of ice at constant stress.

MP 3449

EFFECT OF WAVES ON PANCAKE ICE COLLISIONS.

Frankenstein, S., Shen, H.H., International Offshore and Polar Engineering Conference, 3rd, Singapore, June 6-11, 1993. Proceedings. Vol.2. Edited by J.S. Chung, K. Karal, M.S. Triantafyllou, and R.W. Frederking, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1993, p.712-717, 10 refs.
48-4349

DRIFT, ICE FLOES, PACK ICE, ICE GROWTH, ICE EDGE, ICE WATER INTERFACE, OCEAN WAVES, MATHEMATICAL MODELS, ANTARCTICA—WEDDELL SEA

This study addresses a phenomenon that was observed in the 1986 Winter Weddell Sea Project. A rapid growth of the ice cover in a wave field was reported. The ice cover in that part of the Marginal Ice Zone of the southern ocean was later found to be formed by the freezing of pancake ice. A model which describes the above process has been proposed. This model yields the differential drift caused by the wave motion and demonstrates that floe collisions can be produced by waves. Under freezing condition, such collisions can enhance the growth of an ice cover by welding together neighboring pancake ice floes. In this paper, the model is analyzed to study a broad range of wave and floe parameters. The resulting drift velocity and floe collision frequency are quantified for various floe and wave properties. Results from this analysis in general agree with the few available field observations. (Auth.)

MP 3450

BEHAVIOR OF FIBER-REINFORCED PLASTICS AS CONSTRUCTION MATERIALS IN EXTREME ENVIRONMENTS.

Dutta, P.K., Lampo, R.G., International Offshore and

Polar Engineering Conference, 3rd, Singapore, June 6-11, 1993. Proceedings. Vol.4, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1993, p.339-344, 15 refs.

48-4362
PLASTICS, COMPOSITE MATERIALS, CONSTRUCTION MATERIALS, COLD STRESS, COLD WEATHER PERFORMANCE, FROST RESISTANCE, LOW TEMPERATURE RESEARCH, MICROSTRUCTURE, STRUCTURAL ANALYSIS

Plastic composites made of fiber reinforcements are being increasingly used for structural applications. Their widespread use is motivated primarily by their light weight and corrosion resistance. Low-cost, mass-produced pultruded sections are becoming increasingly competitive with conventional materials like steel and reinforced concrete. However, the conventional design approach and analysis as applied to steel and concrete have serious limitations if directly applied in the design and construction of structures with fiber-reinforced plastics (FRP). These difficulties are rooted primarily in the microstructural characteristics of these materials. This paper summarizes the results of a study and analysis of the effects of severe temperature (cold) on FRP materials.

MP 3451
INFLUENCE OF LAKE MORPHOMETRY ON ICE DATES.

Stewart, K.M., Haugen, R.K., *Internationale Vereinigung für Limnologie. Verhandlungen*, Sep. 1990, No.24, p.122-127, 23 refs.

48-4401
LAKE ICE, FREEZEUP, ICE BREAKUP, ICE GROWTH, ICE FORECASTING, DEGREE DAYS, UNITED STATES—NEW YORK

MP 3452
SCREENING FOR METALS BY X-RAY FLUORESCENCE SPECTROMETRY/RESPONSE FACTOR/COMPTON KA PEAK NORMALIZATION ANALYSIS.

Hewitt, A.D., *American environmental laboratory*, 1994, No.6, p.24-26, 20 refs.

48-4656
ENVIRONMENTAL TESTS, SAMPLING, SOIL ANALYSIS, SOIL POLLUTION, METALS, X RAY ANALYSIS, SPECTROSCOPY, BACKSCATTERING, STANDARDS, PORTABLE EQUIPMENT
This study evaluates the utility of environmental sample analysis by X-ray fluorescence spectroscopy based on a single certified standard and normalization for the incoherent (Compton KA) backscattering for quantifying copper (Cu), zinc (Zn), arsenic (As), and lead (Pb), and finds that it meets the data quality objectives often recommended for field screening.

MP 3453
SPATIAL VARIABILITY OF FALLING WEIGHT DEFLECTOMETER DATA: A GEOSTATISTICAL ANALYSIS.

Kestler, M.A., Harr, M.E., Berg, R.L., Johnson, D.M., International Conference on the Bearing Capacity of Roads and Airfields, 4th, Minneapolis, July 17-21, 1994. Proceedings. Vol.1, Minneapolis, University of Minnesota, 1994, p.317-330, 15 refs.

48-4909
PAVEMENTS, SUBGRADES, BEARING STRENGTH, TRAFFICABILITY, HARDNESS TESTS, PENETRATION TESTS, IMPACT TESTS, STATISTICAL ANALYSIS
Falling Weight Deflectometer (FWD) data and the corresponding pavement stiffness moduli and deflection basin areas vary as functions of both time and space. This paper focuses primarily on extracting information from the spatial variability of FWD deflection data. Spatial variability occurs both horizontally and vertically within a pavement system; it is inherent in the system due to the heterogeneity of the material composing the subgrade, and is further influenced by the construction process and the resulting variations in density, moisture content, and thickness of the subbase, base, and surface layers. To assess spatial variability of just the subgrade and then the overall pavement structure, FWD tests were conducted on 71 test points on top of each of the layers composing a pavement system, and a statistical analysis was conducted on the data. Test pavements included two mainline (five-year design) and two low-volume test cells at the Minnesota Road Research Project (MN/ROAD). By comparing differences between pairs of measured deflections at increasing test point separation distances, one can incorporate distance weighting techniques into a statistical form frequently used in the fields of geology and mining. The geostatistical semi-variogram can be applied to pavements and used to model the degree of correlation between data at any two test points. As the distance between test points increases, corresponding data become increasingly dependent upon each other until, at some appreciable distance, they are independent of each other. From the semi-variogram, one can readily determine the separation distance at which values are independent of each other. Conventional statistical analyses are also used to supplement geostatistical techniques. Valuable and cost-saving information can be acquired by

analyzing baseline FWD data with this technique. The efficiency of future FWD testing can be maximized, and optimum FWD test point spacing can be determined for pavement evaluation and overlay design. Furthermore, the geostatistical techniques discussed are applicable to any problem involving the distribution of a variable in one, two, or three dimensions.

MP 3454
HEAVY WEIGHT DEFLECTOMETER RESULTS FROM AN UNSURFACED ROAD CONTAINING RUBBER LAYERS.

Eaton, R.A., Ashcraft, J., International Conference on the Bearing Capacity of Roads and Airfields, 4th, Minneapolis, July 17-21, 1994. Proceedings. Vol.2, Minneapolis, University of Minnesota, 1994, p.1263-1272, 3 refs.

48-4914
ROAD MAINTENANCE, SUBGRADES, THERMAL INSULATION, FROST PROTECTION, BEARING STRENGTH, TRAFFICABILITY, WASTE DISPOSAL

Currently the State of Maine is investigating the use of scrap rubber tire chips as a fill layer beneath both paved and unpaved roads. As part of this investigation an unsurfaced road test site was constructed in the town of Richmond in Aug. 1992. The investigation included five construction designs incorporating scrap tire rubber layers. Two control sections consist of an existing unmodified road and a reconstructed section without scrap tire rubber. To assess the performance of these scrap tire rubber designs the following data were gathered: (1) meteorological data, (2) temperature profiles of the road at various depths and (3) Heavy Weight Deflectometer (HWD) deflections with the various designs and with the time of the year. Baselines were established for determining how often the HWD data needed to be gathered as well as how many data points need to be gathered within each section. The paper discusses the objectives of the test, the development of a test plan, the results of analysis, and conclusions and recommendations.

MP 3455
PAVEMENT RESPONSE AND PAVEMENT PERFORMANCE STUDIES AT THE NEW DENVER INTERNATIONAL AIRPORT.

Harrison, J.A., Hovan, J.M., Janoo, V.C., International Conference on the Bearing Capacity of Roads and Airfields, 4th, Minneapolis, July 17-21, 1994. Proceedings. Vol.2, Minneapolis, University of Minnesota, 1994, p.1411-1428.

48-4916
RUNWAYS, PAVEMENTS, FROST RESISTANCE, BEARING STRENGTH, TRAFFICABILITY, STRAIN TESTS, UNITED STATES—COLORADO—DENVER

A section of pavement on Runway 16L-34R at the new Denver airport has been instrumented to study static and dynamic strains, deflections, joint openings, temperature, frost penetration depth, and moisture values. Data acquisition is fully automated, and real-time data are to be simultaneously acquired by the Federal Aviation Administration (FAA) and the Waterways Experiment Station (WES). Loading tests will be conducted with an instrumented Boeing 727, an F-15 load cart, a Dynatest heavy weight deflectometer (HWD), and several military aircraft. After the opening of the airport, loadings will be induced by commercial aircraft traffic. The instrumentation selected for monitoring the pavement response and the installation procedures are presented.

MP 3456
REVIEW OF THE FRICTION OF SNOW SKIS.

Colbeck, S.C., *Journal of sports sciences*, 1994, Vol.12, p.285-295, 36 refs.

48-4952
SNOW PHYSICS, SKIS, SURFACE TEMPERATURE, SLIDING, PLASTICS SNOW FRICTION, ICE SOLID INTERFACE, SURFACE ROUGHNESS, WATER FILMS, MELT WATER, HEAT LOSS

Snow friction results from a mixture of processes. With little meltwater present, the surfaces are partially separated and, when too much water is present, the contact area increases and there may be capillary attachments. Slider thermal conductivity and even color are very important. Heat is generated by friction and solar radiation absorption and is conducted away by both slider and ice particles. The remaining heat is available to generate meltwater which acts as a lubricant. While sliders must be designed for use over a narrow range of snow and weather conditions, polyethylene bases can be structured and waxed to broaden that range. The important processes operate not at the air temperature, but at the ski base temperature, which is highly dependent on such things as snow-surface temperature, load and speed. The roughness elements and contact areas must be characterized before the basic processes can be understood further.

MP 3457
MODELING THE EQUILIBRIUM PARTITIONING OF ORGANIC CONTAMINANTS BETWEEN PTFE, PVC, AND GROUNDWATER.

Leggett, D.C., Parker, L.V., *Environmental science &*

technology, July 1994, 28(7), p.1229-1233, 30 refs.

48-4953
GROUND WATER, WATER POLLUTION, ENVIRONMENTAL TESTS, SAMPLING, WELL CASINGS, SOLUTIONS, LIQUID SOLID INTERFACES, POLYMERS, ACCURACY, CORRELATION, MATHEMATICAL MODELS

Sorption of contaminants by organic polymers used in well casings and sampling devices has the potential to bias the results of groundwater analysis. Until now, no attempt has been made to explain quantitatively the results of sorption experiments. Here a multiparameter linear solvation energy relationship was developed to describe the equilibrium partitioning between water, poly(vinyl chloride), and poly(tetrafluoroethylene) of a group of organic compounds selected for their interest to environmental agencies as potential groundwater contaminants. Partitioning of these solutes was related to their basicity, acidity, polarity/polarizability, and molecular volume. These models proved more accurate than octanol/water partition coefficients in correlating the experimental partitioning data. This is because specific interactions with the materials and with octanol restrict its usefulness as a surrogate.

MP 3458
PREPARATION OF SPIKED SOILS BY VAPOR FORTIFICATION FOR VOLATILE ORGANIC COMPOUNDS ANALYSIS.

Hewitt, A.D., *Journal of the Association of Official Analytical Chemists International*, 1994, 77(3), p.735-737, 15 refs.

48-4954
SOIL POLLUTION, ENVIRONMENTAL TESTS, SOIL TESTS, SAMPLING, CHEMICAL ANALYSIS, ACCURACY, HYDROCARBONS, STANDARDS, VAPOR TRANSFER, LABORATORY TECHNIQUES

This paper describes a vapor fortification method for preparing quality assurance/quality control soils for volatile organic compound analysis. Treatment of soils with volatile organic compounds occurs in a closed container in a manner somewhat analogous to the way the vadose zone often becomes contaminated. One advantage of this method for preparing soils for quality assurance/quality control purposes is that the efficiency of various extraction methods can be reliably compared. Furthermore, by substantially reducing the error due to sample inhomogeneity, the error associated with the determinative step can also be properly evaluated.

MP 3459
PHYSICAL, CHEMICAL, AND BIOLOGICAL EFFECTS OF CRUDE OIL SPILLS AFTER 15 YEARS ON A BLACK SPRUCE FOREST, INTERIOR ALASKA.

Collins, C.M., Racine, C.H., Walsh, M.E., *Arctic*, June 1994, 47(2), p.164-175, 29 refs.

48-5115
SUBARCTIC LANDSCAPES, TAIGA, SOIL TESTS, OIL SPILLS, CRUDE OIL, WEATHERING, ENVIRONMENTAL IMPACT, FOREST ECOSYSTEMS, SOIL POLLUTION, PERMAFROST TRANSFORMATION, ACTIVE LAYER, VEGETATION PATTERNS, DEGRADATION, UNITED STATES—ALASKA

The effects of two large experimental crude oil spills conducted in the winter and summer of 1976 in a permafrost-underlain black spruce forest of interior Alaska were assessed 15 years after the spills. Effects on permafrost, as determined from measurements of active layer thaw depths and of the total amount of ground subsidence, were far more pronounced on the winter spill due to a larger surface-oiled area. The winter spill also had a more drastic effect on the vegetation. Where the black, asphalt-like surface oil was present, black spruce mortality was 100% and there was very little live plant cover except for cotton grass tussocks. Changes in oil chemistry varied with depth; surface samples had signs of microbiological degradation, whereas some subsurface samples taken just above the permafrost had no evidence of degradation and still contained volatile fractions.

MP 3460
PERMAFROST MAPPING USING GRASS.

Haugen, R.K., Greeley, N.H., Collins, C.M., International Conference on Permafrost, 6th, Beijing, China, July 5-9, 1993. Proceedings. Vol.2, Guangzhou, South China University of Technology Press, 1993, p.1128-1131, 15 refs.

48-5212
PERMAFROST SURVEYS, PERMAFROST DISTRIBUTION, PERMAFROST FORECASTING, PERMAFROST THERMAL PROPERTIES, FROZEN GROUND TEMPERATURE, SOIL MAPPING, COMPUTER PROGRAMS, UNITED STATES—ALASKA—CARIBOU-POKER CREEKS
Knowledge of the spatial occurrence of permafrost is critical for hydrologic and engineering purposes. The site for the present study is the Caribou-Poker Creeks Research Watershed, a 37 sq mile area near Fairbanks, AK. The monitoring of air, surface and subsurface ground temperatures since 1986 in this discontinuous permafrost upland taiga environment has provided ground truth data for proximal permafrost and non-permafrost underlain terrain. In the initial analysis, the authors found a significant corre-

lation ($r^2=0.68$) between observed mean annual surface temperature and calculated equivalent latitude for each of the seven drill hole sites. Equivalent latitude is a theoretical index of direct solar radiation incident on a surface, which serves as a measure of thermal energy received at that point. The use of a GIS to provide a spatial distribution for the equivalent latitude index was an obvious next step in mapping permafrost. Arc-Info DLG files of elevation, soil and vegetation developed previously were translated and imported into GRASS. An equivalent latitude map was developed in GRASS using the equivalent latitude algorithm and an algorithm derived from the observed variations of mean annual air temperature with elevation within the watershed.

MP 3461

COMPARISON OF TWO GROUND TEMPERATURE MEASUREMENT TECHNIQUES AT AN INTERIOR ALASKAN PERMAFROST SITE.

Collins, C.M., Haugen, R.K., Horrigan, T.O., International Conference on Permafrost, 6th, Beijing, China, July 5-9, 1993. Proceedings. Vol.2, Guangzhou, South China University of Technology Press, 1993, p.1076-1078.

48-5199

FROZEN GROUND TEMPERATURE, TEMPERATURE MEASUREMENT, PERMAFROST SURVEYS, PERMAFROST SAMPLERS, PERMAFROST THERMAL PROPERTIES

MP 3462

ABS, FEP, FRE AND FRP MATERIALS: ABILITY TO WITHSTAND ATTACK BY ORGANIC SOLVENTS AND SORPTION OF TRACE-LEVEL ORGANICS.

Parker, L.V., Ranney, T.A., Waste Testing and Quality Assurance Symposium, 10th, Arlington, VA, July 11-15, 1994. Proceedings, Washington, D.C., U.S. Environmental Protection Agency, 1994, p.694-708, 19 refs.

48-5413

SOIL POLLUTION, WATER POLLUTION, GROUND WATER, WELL CASINGS, HYDROGEOCHEMISTRY, SOIL CHEMISTRY

This paper examines the suitability of four polymeric materials: acrylonitrile butadiene styrene (ABS), fluorinated ethylene propylene (FEP), fiberglass-reinforced epoxy (FRE) and fiberglass-reinforced plastic (FRP) for potential use as well casings in ground water monitoring wells. Specifically, two of the factors that determine suitability were examined: the ability to withstand attack by organic solvents and sorption of dissolved organic solutes by the well casings. These materials are compared with two commonly used polymeric well casing materials, polyvinyl chloride (PVC) and polytetrafluoroethylene (PTFE). ABS does not appear to be a good material for well casings used to monitor organic contaminants, while FRE looks quite promising.

MP 3463

ROUND-ROBIN STUDY OF PERFORMANCE EVALUATION MATERIALS FOR THE ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN SOIL: PRELIMINARY ASSESSMENT.

Hewitt, A.D., Jenkins, T.F., Grant, C.L., Stutz, M.H., Waste Testing and Quality Assurance Symposium, 10th, Arlington, VA, July 11-15, 1994. Proceedings, Washington, D.C., U.S. Environmental Protection Agency, 1994, p.522-527, 14 refs.

48-5414

SOIL POLLUTION, SOIL CHEMISTRY, SOIL COMPOSITION, SOIL ANALYSIS, SOIL TESTS, WASTES, DETECTION

A round-robin study of the analysis of soil subsamples vapor-fortified organic compounds (VOCs) was recently performed by 12 laboratories. Vapor fortification has been proposed as a method of spiking soils with VOCs so that they can be used as performance evaluation materials. Each laboratory was sent two sets of three different vapor-fortified soil subsamples containing trans-1,2-dichloroethylene (TDCE), trichloroethylene (TCE), benzene (Ben), and toluene (Tol). Analyte concentration estimates for these vapor-fortified soils were obtained using SW846 Method 8240. Preliminary analysis of the results showed a range of relative standard deviations from 9 to 22%, with an average of less than 15%. These results confirm that vapor-fortification treatment, followed by confinement in sealed glass ampoules, is a precise means of preparing and storing VOC-contaminated soil subsamples that can be used in quality assurance programs.

MP 3464

PREEXTRACTION HOLDING TIMES FOR NITROAROMATICS AND NITRAMINES IN SOILS.

Jenkins, T.F., Grant, C.L., Myers, K.F., McCormick, E.F., Waste Testing and Quality Assurance Symposium, 10th, Arlington, VA, July 11-15, 1994. Proceedings, Washington, D.C., U.S. Environmental

Protection Agency, 1994, p.462-473, 17 refs.

48-5415

SOIL POLLUTION, SOIL CHEMISTRY, SOIL COMPOSITION, SOIL ANALYSIS, SOIL TESTS, EXPLOSIVES, DETECTION

Studies were conducted to investigate the maximum acceptable preextraction analytical holding times (MHTs) for nitroaromatic and nitramine explosives in soils. Initial experiments were conducted using three soils fortified with two nitramines, HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine) and RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine), and four nitroaromatics, TNB (1,3,5-trinitrobenzene), TNT (2,4,6-trinitrotoluene), 2,4-DNT (2,4-dinitrotoluene) and tetryl (N-Methyl-N,2,4,6-tetranitroaniline). Fortification was accomplished using aqueous solutions, and spiked concentrations were in the low microgram/g range. Additional studies were conducted with field-contaminated soils from the Crane Naval Surface Warfare Center. These soils had been field-contaminated with HMX, RDX, TNT, and TNB. Fortified samples were held for periods up to 8 weeks in the dark at room temperature (22 C), under refrigeration (2 C), or frozen (-15 C). Field-contaminated samples were held in the dark up to 8 weeks under refrigeration. Whether fortified or field-contaminated, the two nitramines (HMX and RDX) were stable over the 8 week test period at all storage temperatures. For the fortified soils, however, nitroaromatics were reasonably stable when frozen, degraded rapidly at room temperature, and more slowly under refrigeration. TNB and tetryl were the least stable of the four nitroaromatics tested, with losses ranging from 67 to 99% when stored under refrigeration for 7 days. In contrast, TNT and TNB, at very similar concentrations to those in the fortified samples, were quite stable under refrigeration for four field-contaminated soils. When these field-contaminated soils were subsequently fortified with TNT and TNB, rapid degradation under refrigeration was again observed for the added nitroaromatics. The authors conclude that studies using fortified soils can produce very different estimates of MHTs compared to those using field-contaminated soils.

MP 3465

UNMANNED VEHICLE SYSTEM MOBILITY IN COLD REGIONS.

Diemand, D., 21st annual technical symposium and exhibition, AUVS-94, Detroit, May 23-25, 1994. Proceedings manual, Washington, D.C., Association for Unmanned Vehicle Systems, 1994, p.491-493.

48-5416

ALL TERRAIN VEHICLES, SNOW VEHICLES, COLD WEATHER OPERATION, COLD WEATHER PERFORMANCE, ORGANIZATIONS, RESEARCH PROJECTS, BIBLIOGRAPHIES

CRREL's primary mission is to address the unique problems faced in cold regions. To accomplish this mission, the Laboratory has developed a synergistic cooperation between the scientific and engineering research personnel and the Cold Regions Science and Technical Information Analysis Center (CRSTIAC), specifically the Bibliography on Cold Regions Science and Technology. This powerful research tool provides researchers with immediate access to virtually all published materials dealing with low-temperature environments. Leveraging the bibliography, CRREL scientists and engineers, with access to the Laboratory's unique facilities and equipment, are among the world's principal resources for technical information on cold environments. Staff scientists and engineers contribute their experience and expertise not only in active research, but also through synthesis of the vast amounts of information available in the Bibliography. Many of the active research thrusts at CRREL offer direct support to unmanned vehicle operations at low temperatures, including work on mobility and operability.

MP 3466

COMMENTS ON "SOLVATOCHROMIC LINEAR SOLVATION ENERGY RELATIONSHIP IN DESCRIBING DRUG SOLUBILITIES".

Leggett, D.C., *Journal of pharmaceutical sciences*, July 1994, 83(7), p.1065, 2 refs.

48-5417

SOLUTIONS, SOLUBILITY, CHEMICAL PROPERTIES, CHEMICAL ANALYSIS, STATISTICAL ANALYSIS, ACCURACY

MP 3467

FRACTURE OF RIVER ICE COVERS BY RIVER WAVES.

Daly, S.F., IAHR Symposium on Ice, 12th, Trondheim, Norway, Aug. 23-26, 1994. Proceedings. Vol.1, 1994, p.93-102, 24 refs.

48-5546

RIVER ICE, ICE BREAKUP, ICE COVER STRENGTH, ICE CRACKS, ICE DEFORMATION, ICE WATER INTERFACE, WATER WAVES, MATHEMATICAL MODELS

The stresses induced in ice covers by river waves are investigated as a possible mechanism for causing transverse cracks during breakup. The maximum stress levels that river waves can cause in the ice cover are determined over the entire spectrum of waves that may be present at breakup, from very long kinematic or flood waves to very short pressure waves. The ice cover is analyzed as a continuous elastic plate, with only vertical bending in the longitudinal direction being considered. For a given wave amplitude, the

amplitude of ice-cover bending stress has two possible maximums: one when the wavelength is equal to $2(p)l$ (where l is the characteristic length of the ice cover) and a second when the celerity of the propagating wave equals the celerity of a free (homogeneous) wave in the ice plate of the same wavelength. This second maximum is entirely analogous to the "critical" wave speed effect caused by a moving load on a floating ice sheet. The present calculations indicate that the celerities of waves propagating in an ice-covered channel are always less than the celerity of free waves of the same wavelength, and hence only the first maximum is possible. The global minimum wave amplitude required to cause cracks in the ice cover is therefore found at a wavelength of $2(p)l$. At this wavelength, a simple expression describing the minimum wave amplitude causing cracks can be derived; and for reasonable values of the ice properties, this amplitude is quite modest. A possible mechanism for producing waves with wavelengths near $2(p)l$ during dynamic ice cover breakup is then outlined, along with strategies for detecting these waves.

MP 3468

EFFECTS OF NAVIGATION IN ICE ON NEAR-SHORE VEGETATION AND SEDIMENT.

Tuthill, A.M., Zabilansky, L.J., IAHR Symposium on Ice, 12th, Trondheim, Norway, Aug. 23-26, 1994. Proceedings. Vol.1, 1994, p.103-109, 8 refs.

48-5547

RIVER ICE, LAKE ICE, ICE COVER EFFECT, ICE NAVIGATION, SHORE EROSION, ENVIRONMENTAL IMPACT, GREAT LAKES

The Soo Locks in Sault Ste. Marie, MI connect Lake Superior to the St. Marys River and Lakes Huron and Michigan. The U.S. Army Corps of Engineers and the Canadian Department of Transportation operate the locks. In the spring of 1992 the Corps opened the locks on 21 Mar., eleven days earlier than the traditional opening date of 1 Apr. This study assessed the effects of that early season navigation on shorelines, near-shore vegetation and sediment along the St. Marys River, south of the locks. The study focused on the effects of ship-induced ice movement, bottom water currents, and sediment transport in areas where the navigation channels border on wetlands. Of concern was potential damage to emergent plants by ice movement and sedimentation of wetland areas. General conditions of the ice cover and breakup processes were also monitored during the observation period. Three observation sites located offshore of wetland areas were chosen to represent worst-case situations in terms of potential damage to the wetlands and emergent vegetation by vessel passage. Vessel-induced changes in water surface elevation (drawdown and surge), near bottom current velocities and sediment motion were measured at these sites for a wide range of vessel sizes and speeds as well as a variety of ice conditions. As in past studies, ship speed was found to be the single most important factor influencing vessel effects on the shoreline.

MP 3469

PHYSICAL MODEL TO STUDY ICE JAMMING PROCESSES IN THE UPPER NIAGARA RIVER.

Larsen, J., Zufelt, J.E., Crissman, R.D., IAHR Symposium on Ice, 12th, Trondheim, Norway, Aug. 23-26, 1994. Proceedings. Vol.2, 1994, p.694-703, 3 refs.

48-5608

RIVER ICE, ICE JAMS, ICE FORECASTING, ICE CONTROL, RIVER FLOW, FLOW CONTROL, ENVIRONMENTAL TESTS, NIAGARA RIVER

MP 3470

PHYSICAL MODEL STUDIES OF MEASURES TO MITIGATE ICE JAMMING IN THE UPPER NIAGARA RIVER.

Zufelt, J.E., Larsen, J., Crissman, R.D., IAHR Symposium on Ice, 12th, Trondheim, Norway, Aug. 23-26, 1994. Proceedings. Vol.2, 1994, p.704-713, 4 refs.

48-5609

RIVER ICE, ICE JAMS, ICE FORECASTING, ICE CONTROL, RIVER FLOW, FLOW CONTROL, ENVIRONMENTAL TESTS, NIAGARA RIVER

MP 3471

THEORETICAL MODEL FOR ICE-STRUCTURE INTERACTION.

Sodhi, D.S., IAHR Symposium on Ice, 12th, Trondheim, Norway, Aug. 23-26, 1994. Proceedings. Vol.2, 1994, p.807-815, 17 refs. For another version see 48-3017.

48-5619

ICE SOLID INTERFACE, ICE LOADS, ICE PRESSURE, ICE COVER STRENGTH, ICE DEFORMATION, ICE BREAKING, OFFSHORE STRUCTURES, PENETRATION TESTS, MATHEMATICAL MODELS

A theoretical model to simulate ice-structure interaction during intermittent crushing is developed on the basis of experimental results from indentation tests conducted by pushing vertical, flat indentors into the edges of freshwater floating ice sheets. The equations and solutions of each phase of interaction are pre-

sented. Besides simulating the interaction during intermittent crushing, the model is able to simulate the interaction during continuous brittle crushing at high rates of indentation. A few results from the interaction model are presented to show the effect of different factors on the frequency of intermittent crushing and on the velocity at which transition from intermittent to continuous crushing takes place.

MP 3472
RAPID ASSESSMENT OF TRICHLOROETHYLENE IN GROUND WATER.

Hewitt, A.D., Shoop, S.A., *Ground water monitoring and remediation*, 1994, p.116-122, 21 refs. 49-76

GROUND WATER, WATER POLLUTION, ENVIRONMENTAL TESTS, SAMPLING, CHEMICAL ANALYSIS, HYDROGEOLOGY, WELL CASINGS

On-site analysis of trichloroethylene (TCE) in aqueous samples by headspace sample preparation and gas chromatography (HS/GC) provides for quick and precise concentration estimates. This analytical approach is well suited for the on-site determination of volatile organic compounds (VOCs) in a variety of sample matrices, including ground water and saturated and unsaturated soils. For these reasons, HS/GC can be used to establish analyte concentrations on a near real-time basis to help select appropriate casing material during monitoring well installation. This application and the collection of multiple well samples during sampling events facilitates the hydrogeological site interpretation and the formulation of remediation strategies.

MP 3473
COMMENT ON "SEA SPRAY AND THE TURBULENT AIR-SEA HEAT FLUXES" BY EDGAR L. ANDREAS.

Katsaros, K.B., de Leeuw, G., Andreas, E.L., *Journal of geophysical research*, July 15, 1994, 99(C7), p.14,339-14,343, Includes reply. 87 refs. For paper under discussion see 46-4553. 49-168

OCEANOGRAPHY, SEA SPRAY, AIR WATER INTERACTIONS, TURBULENT BOUNDARY LAYER, HEAT FLUX, WATER VAPOR, TURBULENT DIFFUSION, EVAPORATION, MATHEMATICAL MODELS, ACCURACY

MP 3474
SURFACE CHARACTERISTICS OF LEAD ICE.

Perovich, D.K., Richter-Menge, J.A., *Journal of geophysical research*, Aug. 15, 1994, 99(C8), p.16,341-16,350, 27 refs. 49-178

SEA ICE, ICE OPENINGS, ICE GROWTH, YOUNG ICE, SURFACE STRUCTURE, PHYSICAL PROPERTIES, ICE MICROSTRUCTURE, ICE WATER INTERFACE, DENDRITIC ICE, BRINES, SURFACE ROUGHNESS

As part of the Lead Experiment held during Mar. and Apr. 1991 and 1992 in the Alaskan Beaufort Sea, ice properties and surface conditions typical of springtime leads were monitored at three sites during the initial few days of growth. Observations indicate that once the ice thickness reached approximately 2 cm, a thin (1 mm) highly saline skim of brine formed on the surface. After only a few hours of growth the initially smooth surface of the sea ice developed some small-scale roughness. Frost flowers, the result of ice grown from the vapor phase, quickly formed on the surface of the sea ice and continued to develop during the observations. Depending on the temperature, the frost flowers were composed of various ice crystal types, including clumps, stellar dendrites, and needles. The initially fresh frost flowers quickly became salty, reaching salinities as high as 100 ppt. The salinity of both the frost flowers and the surface skim decreased at night as temperatures dropped and additional hoarfrost accumulated on the surface. These decreases were also due in part to the accumulation of snow on the surface of the leads. Combining these observations with simple calculations, possible mechanisms for the development and evolution of the surface skim and frost flowers are discussed. They include the hypothesis that the source of the surface skim is brine expelled upward from the sea ice as it cools; that the surface protrusions serve as nucleation sites for the frost flowers, and that the source of the excess water vapor necessary for frost flower growth is the wet surface skim.

MP 3475
ON THE RIDGING OF INTACT LEAD ICE.

Hopkins, M.A., *Journal of geophysical research*, Aug. 15, 1994, 99(C8), p.16,351-16,360, 14 refs. 49-179

SEA ICE, PRESSURE RIDGES, ICE GROWTH, ICE COVER THICKNESS, ICE COVER EFFECT, ICE MECHANICS, ICE MODELS, ICE FRICTION, MATHEMATICAL MODELS, DYNAMIC PROPERTIES

The sea ice pressure ridging process is modeled using a two-dimensional particle simulation technique. In this model, blocks are broken from an intact sheet of relatively thin lead ice driven against a thick, multiyear floe at a constant speed. The blocks of ice rubble accumulate to form the ridge sail and keel. The energy consumed in ridge growth, including dissipation, is explicitly calculated. A series of numerical experiments are performed to establish the dependence of the energetics on the thickness of the

ice sheet and the friction between blocks. The results suggest that the total energy required to create a pressure ridge is an order of magnitude greater than the potential energy in the ridge structure. The variable thickness of the ice cover is created by deformation, which simultaneously causes formation of thick ice through ridge building and thin ice through lead creation. Since the energy expended in deformation is largely determined by the ridging process, an understanding of the energetics of pressure ridging is critical to the determination of ice strength on a geophysical scale.

MP 3476
OBSERVATIONS AND MODELING OF THERMALLY INDUCED STRESSES IN FIRST-YEAR SEA ICE.

Lewis, J.K., Tucker, W.B., Stein, P.J., *Journal of geophysical research*, Aug. 15, 1994, 99(C8), p.16,361-16,371, 16 refs. 49-180

SEA ICE, ICE MECHANICS, PHYSICAL PROPERTIES, THERMAL STRESSES, ICE CRACKS, CRACKING (FRACTURING), ACOUSTIC MEASUREMENT, VISCOELASTICITY, SNOW COVER EFFECT, ICE HEAT FLUX, ICE AIR INTERFACE, MATHEMATICAL MODELS, CANADA—NORTHWEST TERRITORIES—CORNWALLIS ISLAND

During spring 1992, ice property, geophone, meteorological, and stress data were collected on first-year ice southwest of Cornwallis I. in the Canadian archipelago. One of the goals was to specify the average characteristics of the ice, to use these characteristics in a model of thermally induced stresses in the ice, and examine the fracturing associated with the occurrence of those stresses. The results of simulations with a thermal stress model indicate that stress variations within the ice can be reasonably approximated by a viscoelastic rheology. The geophone data showed both ice-borne and water-borne propagation paths for individual fracturing events. The data imply a detection radius out to 500-600 m for the ice-borne signatures of fractures. An investigation of a region after fracturing showed that (1) fracturing occurred in an area with a 10- to 15-cm snow cover, (2) the snow cover had been scored down to the surface of the ice, and (3) cracks in the ice were found under each location where the snow had been scored. The cracks were 5-6 m long and at least 15 cm deep. A review of these and other experimental results suggests that the forces required to produce fractures in response to natural forcing is greater for first-year floes than for multiyear floes.

MP 3477
EFFECTS OF LOW TEMPERATURE THERMAL CYCLES ON MICRO-CREEP AND OTHER MECHANICAL PROPERTIES OF COMPOSITES.

Bhattacharya, R.K., Dutta, P.K., International Conference on Composites Engineering, 1st, New Orleans, Aug. 28-31, 1994. Proceedings. ICCE/1. Edited by D. Hui, 1994, p.49-50. 49-636

COMPOSITE MATERIALS, LOW TEMPERATURE TESTS, THERMAL STRESSES

MP 3478
GRAPHITE EPOXY LAMINATE PENETRATION AT LOW TEMPERATURES.

Sivapuram, S.K., Nwosu, S.N., Dutta, P.K., Hui, D., International Conference on Composites Engineering, 1st, New Orleans, Aug. 28-31, 1994. Proceedings. ICCE/1. Edited by D. Hui, 1994, p.137-138, 8 refs. 49-637

COMPOSITE MATERIALS, LOW TEMPERATURE TESTS, COLD WEATHER TESTS, PENETRATION TESTS, THERMAL STRESSES

MP 3479
CORPS OF ENGINEERS RESEARCH ON COMPOSITES IN INFRASTRUCTURES.

Dutta, P.K., Lampo, R.G., O'Neil, E.F., Fehl, B.D., Hartman, J.P., International Conference on Composites Engineering, 1st, New Orleans, Aug. 28-31, 1994. Proceedings. ICCE/1. Edited by D. Hui, 1994, p.195-196, 4 refs. 49-638

COMPOSITE MATERIALS, RESEARCH PROJECTS, COLD WEATHER CONSTRUCTION, COLD WEATHER PERFORMANCE

MP 3480
FRACTURE MODEL OF POLYMER COMPOSITES AT LOW TEMPERATURE.

Lu, G.Y., Hui, D., Dutta, P.K., International Conference on Composites Engineering, 1st, New Orleans, Aug. 28-31, 1994. Proceedings. ICCE/1. Edited by D. Hui, 1994, p.311-312, 4 refs. 49-639

COMPOSITE MATERIALS, LOW TEMPERATURE TESTS, COLD WEATHER PERFORMANCE, THERMAL

STRESSES, CRACK PROPAGATION

MP 3481
APPLICATION OF ADVANCED COMPOSITE CRASHWORTHY DESIGNS FOR HIGHWAY GUARDRAILS.

Dutta, P.K., McDevitt, C.F., International Conference on Composites Engineering, 1st, New Orleans, Aug. 28-31, 1994. Proceedings. ICCE/1. Edited by D. Hui, 1994, p.337-338, 1 ref. 49-640

COMPOSITE MATERIALS, ROAD MAINTENANCE, HIGHWAY PLANNING, IMPACT STRENGTH, SAFETY

MP 3482
STRESS WAVES PROPAGATION IN ROCKS AND UNCONSOLIDATED SOIL SAMPLES BY VERTICAL DYNAMIC HOPKINSON BAR.

Nwosu, S.N., Dutta, P.K., Hui, D., International Conference on Composites Engineering, 1st, New Orleans, Aug. 28-31, 1994. Proceedings. ICCE/1. Edited by D. Hui, 1994, p.373-374, 2 refs. 49-641

COMPOSITE MATERIALS, SOIL STRENGTH, IMPACT TESTS, SHOCK WAVES

MP 3483
EFFECT OF TEST METHOD ON WINTER TRACTION MEASUREMENTS.

Shoop, S.A., Young, B., Alger, R., Davis, J., *Journal of terramechanics*, May 1994, 31(3), p.153-161, 10 refs. 49-723

VEHICLES, TIRES, TRACTION, SKID RESISTANCE, MECHANICAL TESTS, MEASURING INSTRUMENTS, RUBBER SNOW FRICTION, CORRELATION, ACCURACY

Traction on winter surfaces was measured using three instrumented vehicles, each designed to measure traction for a different purpose: vehicle mobility research (CRREL instrumented vehicle), commercial tire testing (Uniroyal-Goodrich traction tester), and airport runway safety (Saab friction tester). The traction measured with each method is comparable but there are systematic differences due to the effects of the surface materials and test and analysis techniques. This comparison serves as the basis for collaboration between the various traction testing communities and illustrates the need for well documented, standard test and analysis procedures for traction testing and evaluation.

MP 3484
ANALYTICAL AND NUMERICAL MODELING OF STEADY PERIODIC HEAT TRANSFER IN EXTENDED SURFACES.

Aziz, A., Lunardini, V.J., *Computational mechanics*, 1994, Vol.14, p.387-410, 33 refs. 49-727

HEAT TRANSFER, PIPES (TUBES), HEAT PIPES, INTERFACES, THERMAL RADIATION, SURFACE TEMPERATURE, TEMPERATURE VARIATIONS, OSCILLATIONS, MATHEMATICAL MODELS, THERMAL ANALYSIS

This paper deals with the analytical and numerical approaches that have been used to study periodic or oscillatory heat transfer processes occurring in extended surfaces. The details pertain to harmonic oscillations but many of the methods can be applied to more general periodic functions. For linear problems, the techniques include complex combination, Laplace transforms, finite differences, and boundary elements. For the nonlinear situations, approaches such as finite differences, finite elements, and different combinations of complex temperature, perturbation, series expansions, straightline, and finite differences have proved effective. Following a brief introduction, the applications of each approach are discussed in detail.

MP 3485
DETERMINATION OF ANION CONCENTRATIONS IN INDIVIDUAL SNOW CRYSTALS AND SNOWFLAKES.

Hewitt, A.D., Cragin, J.H., *Atmospheric environment*, 1994, 28(15), p.2545-2547, 17 refs. 49-728

PRECIPITATION (METEOROLOGY), SNOW COMPOSITION, SNOWFLAKES, MELTWATER, CHEMICAL ANALYSIS, SAMPLING, ION DENSITY (CONCENTRATION), LABORATORY TECHNIQUES

Capillary electrophoresis was used to measure the concentration of chloride, sulfate and nitrate in snowflakes and in individual snow crystals. Present handling operations allow analyses to be performed on sample volumes as small as 0.3 microl (e.g. approx. 1 mm dia. spatial dendrite). Preliminary findings suggest that the anion composition of snowflakes varies both temporally and with crystal habit.

MP 3486

PREDATION OF DUCKS POISONED BY WHITE PHOSPHORUS: EXPOSURE AND RISK TO PREDATORS.

Roebuck, B.D., Walsh, M.E., Racine, C.H., Reitsma, L., Steele, B., Nam, S.I., *Environmental toxicology and chemistry*, 1994, 13(10), p.1613-1618, 24 refs.

49-729

WETLANDS, BOTTOM SEDIMENT, WATER POLLUTION, ECOSYSTEMS, ECOLOGY, EXPLOSIVES, ANIMALS, EXPOSURE, CHEMICAL ANALYSIS, ENVIRONMENTAL IMPACT, ENVIRONMENTAL TESTS, UNITED STATES—ALASKA—EAGLE RIVER

White phosphorus (P_4) has been identified as the cause of mortality for dabbling ducks and swans at an estuarine salt marsh in Alaska. Predation of ducks poisoned by P_4 was monitored to assess the extent and range of predator exposures to P_4 . Avian tissues were analyzed for P_4 by gas chromatography. It was observed that both sick and dead dabbling ducks were common prey of bald eagles, herring gulls, and common ravens. Frank signs of P_4 intoxication attracted predators and rendered the ducks easy prey. White phosphorus was found in the tissue remains of ducks that had been preyed upon, thus providing positive evidence that predators were exposed to P_4 . Although P_4 varied widely among individuals, it was generally highest in the gizzard contents followed by fatty tissues such as fat deposits and the skin. White phosphorus was identified in fatty tissues of one eagle and in one herring gull egg, thus providing direct evidence of absorption of P_4 by predators.

MP 3487

EFFECTS OF FROST ACTION ON COVERS AND LINERS CONSTRUCTED IN COLD ENVIRONMENTS.

Erickson, A.E., Chamberlain, E.J., Benson, C.H., International Madison Waste Conference, 17th, Sep. 21-22, 1994, Madison, University of Wisconsin, Department of Engineering Professional Development, 1994, p.198-220, 16 refs.

49-772

WASTE DISPOSAL, LININGS, EARTH FILLS, PERMEABILITY, FREEZE THAW TESTS, FROST RESISTANCE, FROST ACTION, COLD WEATHER PERFORMANCE

The effects of freezing and thawing were examined on the hydraulic conductivity of two compacted natural clay soils, one compacted sand-bentonite mixture, and three geosynthetic clay liners (GCLs). Field and laboratory tests were performed on these materials. The goal of the study was to improve the understanding of how freeze-thaw affects these liner materials and therefore improve the design and construction process. A field test site was constructed at a landfill near Milwaukee, WI. The field test site consisted of five test pads (four of clay and one of sand-bentonite), and nine test pans containing three different GCLs. Results of the investigation showed that freeze-thaw caused large increases in hydraulic conductivity in compacted natural clay, but no measurable change in hydraulic conductivity of the sand-bentonite mixture. Field and laboratory tests on the GCLs showed no significant increase in hydraulic conductivity after freeze-thaw. However, the tests on GCLs provided limited data. In addition, some questions are raised regarding seepage through seams and the hydraulic conductivity of GCLs under low confining pressures. These points warrant further study.

MP 3488

METHODS FOR ASSESSING FREEZE-THAW DAMAGE IN COMPACTED CLAY LINERS.

Benson, C.H., Chamberlain, E.J., Erickson, A.E., International Madison Waste Conference, 17th, Sep. 21-22, 1994, Madison, University of Wisconsin, Department of Engineering Professional Development, 1994, p.185-197, 12 refs.

49-773

WASTE DISPOSAL, LININGS, CLAY SOILS, EARTH FILLS, PERMEABILITY, FREEZE THAW TESTS, FROST RESISTANCE, FROST ACTION, COLD WEATHER PERFORMANCE

Two approaches to assess whether freeze-thaw adversely affects compacted clay liners are compared. The approaches are: (1) comparing measurements of water content and dry unit weight made before and after winter and (2) comparing hydraulic conductivities measured before and after winter. Both approaches were used to assess whether freeze-thaw affected two instrumented test pads exposed to winter weather. The hydraulic conductivity tests were conducted using specimens collected in thin-wall sampling tubes, a frozen soil core barrel, and as large blocks. The comparison showed that misleading conclusions can be drawn if an assessment is based on measurements of water content and dry unit weight or the results of hydraulic conductivity tests conducted on specimens removed in thin-wall sampling tubes. A more accurate evaluation can be made using results of hydraulic conductivity tests on specimens removed with a frozen soil core barrel or as large blocks.

MP 3489

HYPERSPECTRAL CLASSIFICATION USING OPTIMAL PARALLEL ARCHITECTURES.

LaPotin, P.J., McKim, H.L., Airborne Remote Sensing Conference, 1st, Strasbourg, France, Sep. 11-15, 1994. Vol.2, Ann Arbor, Environmental Research Institute of Michigan, 1994, p.601-609, 17 refs.

49-774

IMAGE PROCESSING, DATA PROCESSING, COMPUTER APPLICATIONS, COMPUTER PROGRAMS

Hyperspectral scanners produce significant data volumes that are not easily or efficiently managed using existing image processing systems. Although current image processors do employ parallel architectures, few software tools have been developed that are capable of managing hyperspectral data in real time. As a result, hybrid systems have been developed as research tools with little focus toward commercial users of multi/hyperspectral data. In this paper, algorithms are developed for discrete hyperspectral classification using parallel distributed processors (PDP). The architectures are arranged in layers, where each layer represents a unique sequential operation. During the process of spectral characterization, features are extracted by each architectural layer. As a result, there are commonly as many layers in the PDP as there are bands or sub-regions in the data set. This approach yields specific advantages over the traditional threshold methods of binary encoding and Spectral Angle Mapping (SAM). Unlike binary encoding, the PDP applies an optimal two-step discriminant function. The discriminant function is optimal for band combinations in the hyperspectral volume and can be extended to both parametric and nonparametric data quantization. Unlike the Kruskal (E-S) algorithm, the PDP discriminant function does not require a priori data segmentation, nor does the approach require specific a priori spectral class organization. However, the PDP architecture does employ training methods to help sensitize the algorithm to changes in spectral measures. The training sequence can be eliminated if a complete spectral library is available for the selected spectral bands in the hyperspectral data volume. Since this is seldom the case, PDP architectures should be suitably trained using either representative data volumes (e.g., similar data sets from previous acquisitions) or spectrally equivalent data sets (e.g., data volumes from two or more sensors with similar bandwidth characteristics). In either case, optimal feature discrimination can be achieved using limited training sequences.

MP 3490

INFLUENCE OF SUBFREEZING TEMPERATURES ON THE FLEXURAL BEHAVIOR OF THICK COMPOSITES.

Dutta, P.K., Hui, D., Prasad, Y., Integrated design and manufacturing of composites, New York, American Society of Mechanical Engineers, 1994, p.131-139, 20 refs.

49-775

COMPOSITE MATERIALS, FROST RESISTANCE, LOW TEMPERATURE TESTS, COLD STRESS, THERMAL STRESSES, FLEXURAL STRENGTH

The influence of low temperatures and low-temperature thermal cycling on the Young's modulus and transverse shear modulus of two glass-reinforced polyester composites has been investigated. The results were obtained experimentally by three-point bending, using a procedure to determine the "form factor of shear" for different span-to-depth ratios, and then obtaining the Young's and shear moduli simultaneously. For the first composite, which has a plain weave and glass reinforcement, the moduli were obtained at 27, -40, and -60 °C. Within this range of temperatures, no significant effects on moduli were observed. The materials were then subjected to 250 thermal cycles between 50 and -60 °C following which their moduli values at room temperature were found to be degraded. The second batch of pultruded fiber composites showed a consistent increase of their moduli with temperature reduction.

MP 3491

TECHNICAL RESEARCH AREA 6: SNOW AND ICE CONTROL ON HIGHWAYS AND BRIDGES.

Minsk, L.D., Abele, G., Itagaki, K., *U.S. Strategic Highway Research Program. SHRP research plans*, 1986, 26p. + appends., 13 refs.

49-779

RESEARCH PROJECTS, ROAD ICING, ICE REMOVAL, SNOW REMOVAL, CHEMICAL ICE PREVENTION, SALT-ING, ROAD MAINTENANCE, HIGHWAY PLANNING

The great dependence on highway transportation for the movement of goods and people in the United States has led to the demand for rapid, effective clearance of snow and ice from roads. This in turn has led to the use of large quantities of environmentally undesirable chemicals to assist in improving traction between rubber tire and pavement. Concern about the effects of the most heavily used deicing chemical, salt (sodium chloride), on the roadside environment, water supplies, and highway structures, has increased along with the increase in quantities applied, now over 10,000,000 tons per year. A research plan is presented which has as its primary objective the reduction of the dependence on environmentally undesirable chemicals. Reducing the quantity of deicing chemicals applied to the nation's highways can be accomplished by the development of innovative products and techniques and the incorporation of some existing sophisti-

cated technology in snow and ice control organizations. The principal approach to achieving this is the development of physical methods of disbonding ice from pavements, or preventing the bond from developing. Fundamental studies of bond formation and prevention are proposed as the most promising and cost-effective initial attacks on the problem rather than pursuing the largely empirical approaches of present research on snow and ice control. These fundamental studies will provide the background for developing pavement modifications to reduce or eliminate ice adhesion. Increased reliance on physical methods will require improvements in the backbone of the snow and ice control organization: the displacement plow and its cutting edge. Research is also proposed to improve control of snow and ice removal operations by providing management with real-time information on pavement and weather conditions over the entire system, improving storm warning capabilities and timeliness, and developing a communications system to ensure rapid and thorough response to changing conditions.

MP 3492

PATHOGEN REDUCTION CAPABILITIES OF FREEZE/THAW SLUDGE CONDITIONING.

Sanin, F.D., Vesilind, P.A., Martel, C.J., *Water research*, Nov. 1994, 28(11), p.2393-2398, 22 refs.

49-868

WASTE TREATMENT, SLUDGES, WASTE DISPOSAL, FREEZE THAW CYCLES, MICROBIOLOGY, BACTERIA, SURVIVAL, FREEZING RATE, TEMPERATURE EFFECTS, HEALTH

If freeze/thaw conditioning can be shown to reduce pathogenic microorganisms, then sludges treated in this fashion can be disposed of on land with less risk of health effects. In this paper, the effects of freezing rate, temperature and time in the frozen state on the removal of pathogens are tested. The response of seven indicators of microbial contamination—fecal coliforms, *Salmonella*, plaque forming units, fecal streptococci, poliovirus, helminths and protozoa—to the freeze/thawing of both aerobically and anaerobically digested sludges is examined. Fecal coliforms, fecal streptococci, and plaque forming units are chosen as the commonly used indicators of bacteria and viruses in wastewater sludges. Pathogenic bacteria, virus and parasites tested in the second phase are chosen as sample microorganisms in their respective classes. Freeze/thaw sludge conditioning is proven to be an effective means of removing most pathogenic microorganisms. Fecal streptococci are found to be the best indicator of the effectiveness of freeze/thawing on enteric bacteria. Results of this study indicate that freeze/thaw conditioning coupled with sludge digestion can significantly enhance the overall pathogenic microorganism reduction achieved in a wastewater treatment plant. Added effectiveness by freeze/thaw treatment may become critical for a plant in meeting the pathogen reduction requirements by U.S. regulations prior to any practice of land application or land disposal of sludge.

MP 3493

ICE GRAIN ORIENTATION IN PROCESSED SNOW.

Adams, E.E., Vandervoort, D.C., Edens, M.Q., Lang, R.M., International Symposium on Snow and Related Manifestations, Manali, India, Sep. 26-28, 1994. Extended abstracts, Manali, India, Snow and Avalanche Study Establishment, 1994, p.27-30, 2 refs.

49-896

SNOW COMPACTION, SNOW (CONSTRUCTION MATERIAL), SNOW ROADS, SNOW COVER STRUCTURE, SNOW DENSITY, SNOW STRENGTH, MICROSTRUCTURE

MP 3494

EFFECTIVE MEDIUM APPROXIMATION FOR SNOW THERMAL CONDUCTIVITY.

Arons, E.M., Colbeck, S.C., McGillivray, W.R., Petrenko, V.F., International Symposium on Snow and Related Manifestations, Manali, India, Sep. 26-28, 1994. Extended abstracts, Manali, India, Snow and Avalanche Study Establishment, 1994, p.45-48, 13 refs.

49-901

SNOW THERMAL PROPERTIES, SNOW HEAT FLUX, SNOW COVER STRUCTURE, METAMORPHISM (SNOW), THERMAL CONDUCTIVITY, MICROSTRUCTURE

MP 3495

EFFECTS OF CAPILLARY DISCONTINUITIES ON WATER FLOW AND WATER RETENTION IN LAYERED SNOW COVERS.

Jordan, R., International Symposium on Snow and Related Manifestations, Manali, India, Sep. 26-28, 1994. Extended abstracts, Manali, India, Snow and Avalanche Study Establishment, 1994, p.53-56, 9 refs.

49-903

SNOW HYDROLOGY, SNOWMELT, SNOW PERMEABILITY, SNOW STRATIGRAPHY, SEEPAGE, RUNOFF FORECASTING, WATER RETENTION, CAPILLARITY

MP 3496

PHYSICS OF SNOW FRICTION.

Colbeck, S.C., International Symposium on Snow and Related Manifestations, Manali, India, Sep. 26-28, 1994. Extended abstracts, Manali, India, Snow and Avalanche Study Establishment, 1994, p.63-65, 8 refs.

49-905

PLASTICS SNOW FRICTION, SKIS, ICE SOLID INTERFACE, SLIDING, WATER FILMS

MP 3497

SOVIET STUDIES OF COLD WEATHER PHENOMENA IN SUBARCTIC SEAS.

Assur, A., U.S. Navy Symposium on Arctic/Cold Weather Operations on Surface Ships, Nov. 19-20, 1987. Proceedings, Vol.1, Washington, D.C., Department of the Navy, 1987, p.197-210, 43 refs.

49-980

SHIPS, SHIP ICING, COLD WEATHER OPERATION, ICE CONTROL, ICE PREVENTION, ICE REMOVAL, BIBLIOGRAPHIES, RUSSIA

MP 3498

SEA ICE CONDITIONS IN ARCTIC MARINAL ICE ZONES.

Tucker, W.B., U.S. Navy Symposium on Arctic/Cold Weather Operations on Surface Ships, Nov. 19-20, 1987. Proceedings, Vol.1, Washington, D.C., Department of the Navy, 1987, p.271-281, 10 refs.

49-984

SEA ICE DISTRIBUTION, ICE EDGE, ICE CONDITIONS, ICE GROWTH, SEASONAL VARIATIONS, BERING SEA, CHUKCHI SEA

MP 3499

VARIATION IN AEROSOL CONCENTRATION ASSOCIATED WITH A POLAR CLIMATIC ITERATION.

Hogan, A., Riley, D., Murphey, B.B., Barnard, S.C., Samson, J.A., *American Geophysical Union. Antarctic research series*, 1993, Vol.61, Antarctic meteorology and climatology: studies based on automatic weather stations, p.175-199, Refs. p.196-199.

49-968

AEROSOLS, MARINE DEPOSITS, SEASONAL VARIATIONS, WIND (METEOROLOGY), CLIMATIC FACTORS, ICE COMPOSITION, ANTARCTICA—ROSS ICE SHELF

This paper presents analyses which follow warm, aerosol-laden cyclonic systems across the Ross Ice Shelf, using automatic weather station data. Subsequent discussion indicates that marine aerosol deposits in the interior antarctic ice may reflect a recent climatic iteration of surface temperature aerosol concentration. The antarctic continental (cA) air mass is rarely displaced from the south polar plateau, but is frequently modified by exchange with antarctic maritime (mA) air advected from the ice shelves or frozen seas or with polar maritime (mP) air advected from the southern oceans. Because the cA air mass resides over an uninhabited and relatively static ice-covered surface, the concentration of aerosol particles in this unique air mass may reflect aerosol variation in the global atmosphere. A continuous series of surface observations were begun at Amundsen-Scott Station in 1974 and have continued to the present. The decrease in aerosol concentration was greatest in late winter and spring, concurrent with decreases in mean air temperature and mean wind speed. This paper describes analytical techniques used to examine these apparent trends. It is concluded that the diminution in temperature, aerosol concentration, and sodium deposition are a consequence of a diminution in the frequency of cyclonic-related warming events. (Auth.)

MP 3500

GROUNDWATER MONITORING WELL CASINGS.

Parker, L.V., Hewitt, A.D., Jenkins, T.F., Ranney, T.A., Leggett, D.C., *Military engineer*, 1993, No.565, p.15-16.

49-996

GROUND WATER, WATER POLLUTION, SAMPLING, ENVIRONMENTAL TESTS, ACCURACY, WELL CASINGS, MATERIALS, LEACHING, STANDARDS

MP 3501

RAPID STABILIZATION OF THAWING SOILS.

Kestler, M.A., Henry, K.S., Shoop, S.A., 17th annual meeting, Corvallis, OR, July 24-29, 1994. Proceedings. Advanced technology in forest operations: applied ecology in action, Corvallis, Council on Forest Engineering, 1994, p.291-306, 29 refs.

49-1026

GROUND THAWING, THAW WEAKENING, SOIL TRAFFICABILITY, SOIL STABILIZATION, GEOTEXTILES

While seasonally frozen soils undergoing thawing must be able to

support the loads imposed by both civilian and military equipment and vehicles, at present the US Army lacks a procedure for addressing methods of handling thaw-induced immobilization. In response to this lack of guidance, the US Army Corps of Engineers Cold Regions Research and Engineering Laboratory (USACRREL) recently commenced a study to assess a variety of environmentally safe chemical and mechanical stabilization techniques. The stabilized surface must be capable of supporting both wheeled and tracked transport of materials, supplies, and personnel and must withstand at least limited repeated traffic. Additional criteria include simplicity of construction, expediency, material availability, and economics. The research project is being conducted in phases over a period of two or three years. This paper focuses on Phase I, a review of current stabilization practices used by forestry industries and/or tested by the military or USDA Forest Service. It discusses a variety of mechanical and chemical stabilization techniques including debris mat/slash, wooden mats, chuckwood, tire mats, grating, military aircraft landing mats, geogrids, geotextiles, geocells, and chemical admixtures. Future phases, including plans for the development of a demonstration project, are also discussed briefly.

MP 3502

RESPONSE OF NATURAL SNOW TO EXPLOSIVE SHOCK WAVES.

Solie, D.J., Johnson, J.B., Barrett, S.A., Joint AIR-APT/APS Topical Group on Shock Compression of Condensed Matter Conference, Colorado Springs, CO, June 28-July 2, 1993. Proceedings. High-pressure science and technology-1993, New York, American Institute of Physics, 1994, p.1139-1142, 9 refs.

49-1027

SNOW STRENGTH, SNOW COMPRESSION, SNOW COVER EFFECT, SHOCK WAVES, DETONATION WAVES, BLASTING, EXPLOSION EFFECTS, ATTENUATION

Field measurements of shock waves in snow with initial densities from 100 kg/m³ to 555 kg/m³ were made in situ in a natural snow cover. A high amplitude, short duration, uniaxial shock impulse (about 0.6 GPa for 10 microseconds) was imparted to the snow using sheet explosive, and the shock arrival time and stress histories were measured at depth in the snow. For dry snow ($\rho = 250 \pm 30$ kg/m³), the shock velocity can be described by a power law and decays rapidly with depth, from over 1000 m/s near the snow/explosive interface to 120 \pm 20 m/s at 0.20 m. The shock stress attenuation factor at a propagation depth of 0.20 m is about 4×10^{-3} . Tests in which explosive gases were excluded from the snow had higher shock velocities and pressures than tests where the gases penetrated the snow.

MP 3503

CORRECTION.

Parker, L.V., *Ground water monitoring & remediation*, 1994, 14(3), p.275, 4 refs.

49-1034

GROUND WATER, WELL CASINGS, SAMPLING, BIBLIOGRAPHIES, ACCURACY

MP 3504

WINTER TRACTION TESTING.

Shoop, S.A., Young, B., Alger, R., Davis, J., *Automotive engineering*, Jan. 1994, 102(1), p.75-78.

49-1035

TIRES, MECHANICAL TESTS, COLD WEATHER TESTS, TEST EQUIPMENT, TRACTION, RUBBER SNOW FRICTION, RUBBER ICE FRICTION, SKID RESISTANCE, CORRELATION, STANDARDS

MP 3505

TECHNIQUES FOR CONTROLLING ICE AT DAMS AND HYDROPLANTS.

Haynes, F.D., *Hydro review*, Oct. 1994, 13(6), p.86-88.

49-1036

DAMS, ELECTRIC POWER, WATER INTAKES, RIVER ICE, ICE CONTROL, ICE MELTING, HYDRAULIC JETS, HEAT SOURCES, DESIGN, COLD WEATHER TESTS

MP 3506

EFFECTS OF GROUND WATER SAMPLING DEVICES ON WATER QUALITY: A LITERATURE REVIEW.

Parker, L.V., *Ground water monitoring & remediation*, 1994, 14(2), p.130-141, 46 refs.

49-1037

GROUND WATER, WATER POLLUTION, ENVIRONMENTAL TESTS, SAMPLING, SAMPLERS, PERFORMANCE, ACCURACY, IMPURITIES

This paper reviews both field and laboratory studies that tested or compared the ability of various types of sampling devices to deliver representative ground water samples. Several types of grab samplers, positive displacement devices, and suction-lift devices were evaluated. Gas-lift and inertial-lift pumps were also evaluated. This study found that most of these devices can, under certain circumstances, alter the chemistry of ground water samples. Gas-lift pumps, older types of submersible centrifugal pumps, and suction-lift devices are not recommended when sam-

pling for sensitive constituents such as volatile organics and inorganics, or inorganics that are subject to oxidation/precipitation reactions. In general, the devices reviewed in this paper, bladder pumps gave the best recovery of sensitive constituents. However, better performance could be achieved for several devices if improved operational guidelines were developed by additional testing, especially at lower flow rates.

MP 3507

EFFECT OF CONCENTRATION ON SORPTION AND DISSOLVED ORGANICS BY PVC, PTFE, AND STAINLESS STEEL WELL CASINGS.

Parker, L.V., Ranney, T.A., *Ground water monitoring & remediation*, 1994, 14(3), p.139-149, 25 refs.

49-1038

GROUND WATER, WATER POLLUTION, SAMPLING, ACCURACY, ENVIRONMENTAL TESTS, WELL CASINGS, ABSORPTION, STEELS, POLYMERS, CHEMICAL ANALYSIS

This report examines sorption of low ppb levels of organic solutions by polytetrafluoroethylene (PTFE), rigid polyvinyl chloride (PVC), and stainless steel 304 and 316 well casings. Nineteen organics were selected, including several munitions and chlorinated solvents. Compounds were selected to offer a range of physical properties, such as solubility in water, octanol/water partition coefficient, and molecular structure. When these results were compared with the results from a similar study conducted at ppm levels, the rate and extent of sorption by PTFE and PVC were the same as seen previously for almost all analytes. There were no losses of any compounds associated with stainless steel. At these low levels (ppm and ppb), the rate of diffusion within the polymer (PVC and PTFE) is independent of concentration. Only with PTFE are the rates rapid enough to be of concern when monitoring for some contaminants in ground water. Tetrachloroethylene was the compound PTFE sorbed the most rapidly. The study showed the PVC well casings are suitable for monitoring low levels (ppm and ppb) of organics.

MP 3508

SOME PHYSICAL FACTORS AFFECTING CONTAMINANT HYDROLOGY IN COLD ENVIRONMENTS.

Grant, S.A., *Transportation research record*, 1994, No.1434, p.61-69, 13 refs.

49-1041

SOIL POLLUTION, WATER POLLUTION, HYDROLOGY, TEMPERATURE EFFECTS, SUBPERMAFROST GROUND WATER, WATER TRANSPORT, SOIL WATER MIGRATION, SNOW COVER EFFECT, FROZEN GROUND CHEMISTRY, FROZEN GROUND THERMODYNAMICS, MATHEMATICAL MODELS

Some of the physical effects of cold temperatures that should be considered when developing a contaminant-transport model are surveyed in this paper. The discussion begins with the following working definition of the term cold region for the purpose of contaminant hydrology modeling: an area with appreciable frozen ground and a substantial fraction of the annual precipitation as snow. Models that estimate the liquid water content and hydraulic conductivity of frozen ground are discussed.

MP 3509

REROOFING THE WINDIEST PLACE ON EARTH WITH A MODIFIED BITUMEN PROTECTED MEMBRANE.

Tobiasson, W., Buska, J., Low-Slope Reroofing Workshop, Oak Ridge, TN, May, 24-25, 1994. Proceedings, Oak Ridge, TN, Oak Ridge National Laboratory, 1994, p.207-220, 15 refs. For another version see 48-3962.

49-1310

ROOFS, WATERPROOFING, VAPOR BARRIERS, THERMAL INSULATION, WEATHERPROOFING, WIND FACTORS, BITUMENS

In a protected membrane roofing system, insulation is placed above the membrane to keep the waterproofing layer out of harm's way. Ballast holds the extruded polystyrene insulation in place and protects it from the sun and traffic. Such a roof was installed several years ago for a building on the windy summit of Mt. Washington in New Hampshire. The loose-laid membrane leaked. Recently it was replaced with a fully-adhered modified-bitumen protected membrane. The design rationale and installation of the new system at this wet, windy place are discussed. The installation was successful and the new roofing system is performing well.

MP 3510

CONSIDERING MOISTURE WHEN DECIDING WHAT TO DO WITH A PROBLEMATIC LOW-SLOPE ROOF.

Tobiasson, W., Low-Slope Reroofing Workshop, Oak Ridge, TN, May, 24-25, 1994. Proceedings, Oak Ridge, TN, Oak Ridge National Laboratory, 1994,

p.65-76, 17 refs.

49-1309

ROOFS, MOISTURE DETECTION, WATERPROOFING, VAPOR BARRIERS, THERMAL INSULATION, VENTILATION

Moisture is particularly important to consider when selecting a reroofing option. In order to make an intelligent selection, it should be determined if moisture is present in the existing system. Some moisture can be detected non-destructively by nuclear, capacitance, or infrared roof moisture surveys. Such findings should be verified by core samples taken in areas expected to be wet and others expected to be dry. Since the roof may have been damaged in the past by moisture that has since dissipated, roof moisture surveys will not find all moisture-related problems in all roofs. Visual inspections and test cuts are needed to determine if corrosion, delamination, or other problems exist. Other tests (e.g., in-place wind uplift tests) may also be needed to determine the extent to which moisture has damaged the existing system. Test cuts and cores used to verify roof moisture survey findings provide evidence on the composition of the roof. All this information should influence the selection of a reroofing option.

MP 3511

EXAMINATION OF THE THERMAL BEHAVIOR OF A GRAVEL BACKGROUND AND ITS INFLUENCE ON PASSIVE INFRARED INTRUSION DETECTION.

Lacombe, J., 35th annual meeting, Naples, FL, July 17-20, 1994. Proceedings, Northbrook, IL, Institute of Nuclear Materials Management, 1994, p.324-329, 7 refs.

49-1315

INFRARED RECONNAISSANCE, WARNING SYSTEMS, DETECTION, SENSORS

A paper presented by the author at the 1993 INMM annual meeting described a study which compared the suitability of five different surface types (sand, asphalt, grass, concrete and gravel) as backgrounds for a passive thermal infrared intrusion detection system (IDS). Experimental surface temperature and meteorological data recorded during July 92 at a test site in New Hampshire were utilized in the study as well as models for predicting intruder surface temperature and infrared IDS performance. For the period investigated, the predicted number of "missed" intruder crossings was lowest for the gravel surface. This raised the question as to whether gravel backgrounds are preferable in general for such an IDS application. A follow-up investigation was initiated at a test site in Vermont to address this issue. This study examines the thermal behavior of a gravel bed and how it influences both the nuisance alarm rate and the intruder detection capability of an infrared IDS. Experimental results for this gravel bed and an adjacent grassy area are presented in this paper. A simple model is also described which is used to examine the influence of gravel aggregate size, vegetative and structural "clutter" and wind speed on gravel surface temperatures.

MP 3512

AUTUMN BLOOM OF ANTARCTIC PACK ICE ALGAE.

Fritsen, C.H., Lytle, V.I., Ackley, S.F., Sullivan, C.W., *Science*, Nov. 4, 1994, 266(5186), p.782-784, 26 refs.

49-1069

SEA ICE, ALGAE, SEA WATER, CHEMICAL COMPOSITION, NUTRIENT CYCLE, ANTARCTICA—WEDDELL SEA

An autumn bloom of sea-ice algae was observed from Feb. to June of 1992 within the upper 0.4 m of multiyear ice in the western Weddell Sea. The bloom was reliant on the freezing of porous areas within the ice that initiated a vertical exchange of nutrient-depleted brine with nutrient-rich seawater. This replenishment of nutrients to the algal community allowed the net production of 1760 mg of carbon and 200 mg of nitrogen per sq m of ice. The location of this autumn bloom is unlike that of spring blooms previously observed in both polar regions. (Auth.)

MP 3513

ERROR ANALYSIS OF THE TECHNIQUES USED IN THE MEASUREMENT OF HIGH-SPEED FRICTION ON SNOW.

Colbeck, S.C., *Annals of glaciology*, 1994, Vol.19, Symposium on Applied Ice and Snow Research, Rovaniemi, Finland, Apr. 18-23, 1993. Proceedings. Edited by S.J. Jones et al, p.19-24, 13 refs.

49-1085

PLASTICS SNOW FRICTION, MECHANICAL TESTS, ICE SOLID INTERFACE, SLIDING, MEASUREMENT, ACCURACY, SKIS, SLEDS, DESIGN

Controlled tests are needed to find the coefficient of friction of snow as a function of speed. An error analysis shows how the test must be designed to give accurate answers. It seems necessary to use a remotely controlled, aerodynamic sled in place of a skier to get accurate results. Otherwise, two sets of tests are necessary, one to determine air drag versus speed and one to determine the frictional force versus speed, and even these tests would probably not give satisfactory results. The slope used for testing should be steep for a quick acceleration and then uniform, but not flat,

where the actual measurements are taken. A continuously reading speed sensor is needed, not discrete measuring points. Even with the underlying principles understood, there will still be many practical problems to be solved before accurate results can be obtained.

MP 3514

RESPONSE OF A SEASONAL SNOW COVER TO EXPLOSIVE LOADING.

Johnson, J.B., Solie, D.J., Barrett, S.A., *Annals of glaciology*, 1994, Vol.19, Symposium on Applied Ice and Snow Research, Rovaniemi, Finland, Apr. 18-23, 1993. Proceedings. Edited by S.J. Jones et al, p.49-54, 17 refs.

49-1089

SNOW COVER STABILITY, SNOW MECHANICS, SNOW AIR INTERFACE, EXPLOSIVES, EXPLOSION EFFECTS, SHOCK WAVES, SOUND WAVES, WAVE PROPAGATION, ATTENUATION, STRESSES

An explosive detonation in snow produces high intensity shock waves that are rapidly attenuated by momentum spreading as the snow is compacted. Experimental measurements and numerical calculations presented here indicate that the maximum shock-wave attenuation in seasonal snow (250 kg/m^3) is proportional to between $x(\text{sup}-1.6)$ and $x(\text{sup}-1.5)$ for plane waves and x^{-3} for spherical waves (x is the propagation distance). Outside the region of shock-compacted snow or in air over snow, stresses are transmitted as acoustic/seismic waves. Attenuation of these waves depends on snow permeability and the effective modulus of the ice frame and is proportional to about $x(\text{sup}-0.7)$ for plane waves in seasonal snow and to about x^{-1} for spherical waves in air over seasonal snow. Increasing the scaled detonation height of an explosive up to 2 m kgf (sup -1/3) above a snow cover increases the far field (scaled distances greater than about 8 m kgf (sup -1/3)) snow surface pressures. Scaled detonation heights greater than about 2 m kgf (sup -1/3) have little additional effect.

MP 3515

EFFECTS OF MICROTOPOGRAPHY ON TEXTURE, TEMPERATURE AND HEAT FLOW IN ARCTIC AND SUB-ARCTIC SNOW.

Sturm, M., Holmgren, J., *Annals of glaciology*, 1994, Vol.19, Symposium on Applied Ice and Snow Research, Rovaniemi, Finland, Apr. 18-23, 1993. Proceedings. Edited by S.J. Jones et al, p.63-68, 25 refs.

49-1091

SNOW PHYSICS, SNOW THERMAL PROPERTIES, TUNDRA, SNOW TEMPERATURE, SOIL TEMPERATURE, HEAT FLUX, TOPOGRAPHIC EFFECTS, MICRORELIEF, ICE SOLID INTERFACE, TEMPERATURE MEASUREMENT

Arctic and sub-arctic snow is deposited on ground that can have significant microrelief due to tundra hummocks and tussocks. The microrelief, a substantial fraction of the total snow depth, causes basal layers of snow (usually depth hoar) to be discontinuous. In-situ measurements made at four locations in Alaska indicate lateral temperature gradients up to 60 C/m exist at the snow/ground interface due to the microtopography. For all sites, the winter average range of temperature along a 1.5 m transect at the interface varied from 4 C to greater than 7 C. Heat-flux transducers placed at the tops and bases of tussocks indicated that vertical heat flow was consistently 1.4 m to 2.1 times higher at the top than the base. Results of a conductive model based on tussock height are consistent with these measurements.

MP 3516

FRICTION OF SNOW SKIS.

Colbeck, S.C., International Snow Science Workshop, Breckenridge, CO, Oct. 4-8, 1992. ISSW '92. Proceedings, Denver, Colorado Avalanche Information Center, [1992], p.18-27, 16 refs.

49-1111

SKIS, PLASTICS SNOW FRICTION, SNOW SURFACE, ICE SOLID INTERFACE, SLIDING, WATER FILMS

Snow friction results from a mixture of processes. Usually the snow and ski surfaces are partially separated by melt water, but when too much water is present, the contact area and friction increase. Ski thermal conductivity and color are very important. Heat is generated by friction and solar radiation absorption and is conducted away by both ski and ice particles. The remaining heat generates melt water, which acts as a lubricant. The important processes operate not at the air temperature, but at the ski base temperature, which is highly dependent on such things as snow-surface temperature, load, and speed.

MP 3517

APPLICATIONS OF CLASSIFICATION TREE METHODOLOGY TO AVALANCHE DATA MANAGEMENT AND FORECASTING.

Davis, R.E., Elder, K., Bouzaglou, E., International Snow Science Workshop, Breckenridge, CO, Oct. 4-8, 1992. ISSW '92. Proceedings, Denver, Colorado Avalanche Information Center, [1992], p.126-133, 11

refs.

49-1123

AVALANCHE FORECASTING, AVALANCHE MODELING, SNOW COVER STABILITY, DATA PROCESSING, COMPUTER APPLICATIONS, STATISTICAL ANALYSIS, UNITED STATES—CALIFORNIA—SIERRA NEVADA

A common problem for avalanche-prone areas subject to forecasting and control responsibility is the identification of a set of critical meteorological parameters. While storm snowfall and snowfall intensity are generally accepted as among the most important, the complex interplay among terrain, wind, temperature, solar radiation and other meteorological variables makes identifying the next most important parameters difficult. Classification tree methodology is introduced as a potential tool for identifying critical meteorological parameters associated with avalanche and control activities. The application of this methodology is described in the context of exploring a subset of the Mammoth Mountain avalanche and meteorology database. The meteorological parameters most important to avalanche occurrence in two years of data were identified from a set of thirteen variables from one observation site. It is shown how this information could be used to provide inputs to forecasting programs and guidance in establishing observation priorities.

MP 3518

ANALYSIS OF AVALANCHE PREDICTION FROM METEOROLOGICAL DATA AT BERTHOUD PASS, COLORADO.

Boyer, H.S., Williams, K., International Snow Science Workshop, Breckenridge, CO, Oct. 4-8, 1992. ISSW '92. Proceedings, Denver, Colorado Avalanche Information Center, [1992], p.229-235, 18 refs.

49-1134

AVALANCHE FORECASTING, AVALANCHE MODELING, AVALANCHE TRIGGERING, SNOW COVER STABILITY, METEOROLOGICAL FACTORS, DATA PROCESSING, STATISTICAL ANALYSIS, UNITED STATES—COLORADO

In an attempt to identify the most critical meteorological parameters influencing the temporal behavior of avalanche release in a continental snowpack, the authors analyze a nineteen-year chronological record of meteorological measurements and avalanche occurrence at Berthoud Pass, CO, in a classification tree approach.

MP 3519

TIME-DOMAIN-REFLECTOMETRY AS A METHOD TO MEASURE SNOW WETNESS AND DENSITY.

Schneebeil, M., Davis, R.E., International Snow Science Workshop, Breckenridge, CO, Oct. 4-8, 1992. ISSW '92. Proceedings, Denver, Colorado Avalanche Information Center, [1992], p.361-364, 4 refs.

49-1150

SNOW SURVEYS, SNOW HYDROLOGY, SNOW WATER CONTENT, SNOW ELECTRICAL PROPERTIES, MOISTURE DETECTION

MP 3520

NORTHERN SEA ROUTE AND ICEBREAKING TECHNOLOGY: AN OVERVIEW OF CURRENT CONDITIONS.

Mulherin, N.D., Sodhi, D.S., Smallidge, E., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, June 1994, 162p., ADA-285 943, Refs. p.55-60, 75-121.

49-1154

ICEBREAKERS, ICE BREAKING, MARINE TRANSPORTATION, NAVIGATION, ICE NAVIGATION, GEOGRAPHY, NORTHERN SEA ROUTE, RUSSIA

The Northern Sea Route (NSR) follows the Eurasian coastline between the Atlantic and Pacific oceans. The USSR developed a marine transportation infrastructure along their northern coastline that includes a fleet of the world's most powerful icebreakers and ice-strengthened cargo ships, port facilities, and navigation, communication, and environmental forecasting aids. In 1987, the USSR announced it would open the NSR to foreign vessels for peaceful and commercial purposes. Navigational difficulties are considerable, due to bitter weather conditions, the short daylight season, ice-infested waters, and isolation. However, shorter distances between north Pacific and European ports, an existing cargo base, a currently underutilized transportation infrastructure, potential stimulation and strengthening of the Russian economy, and the prospect for economic benefits from international investment in Russia make the NSR attractive. The challenging physical environment requires advances in ship design and ship operations. Modern polar ships are larger, stronger, and more powerful, their propulsion systems have been improved, and the resistance encountered during icebreaking has been reduced. The existing shallow-draft northern fleet may be undesirable for use where larger ships can move cargo more efficiently. More northerly route options would enable larger and perhaps more efficient ship passage but would also require greater icebreaking capabilities; however, it will be difficult to attract greater foreign interest unless the navigation season can be extended.

MP 3521

AUTOMATED ICE-OCEAN ENVIRONMENTAL BUOYS (IOEBS) FOR THE TELEMETRY OF AIR, ICE AND OCEAN DATA FROM THE POLAR OCEANS.

Krishfield, R., Honjo, S., Tucker, W.B., Nakanishi, T., Takizawa, T., Oceans'93 Conference, Victoria, British Columbia, Oct. 18-21, 1993. Proceedings. Vol.2, New York, Institute of Electrical and Electronics Engineers, 1993, p.II47-II52, 7 refs. 49-1185

AIR ICE WATER INTERACTION, ICE SURVEYS, ICE COVER THICKNESS, ICE TEMPERATURE, ICE DEFORMATION, DRIFT STATIONS, SUBGLACIAL OBSERVATIONS, OCEANOGRAPHIC SURVEYS, OCEAN CURRENTS, TELEMETERING EQUIPMENT

The Ice-Ocean Environmental Buoy (IOEB) was developed to acquire and telemeter in near real-time inter-relatable time-series data on atmospheric, oceanographic and ice physics in ice-covered oceans during all seasons. Mechanically, the IOEB consists of an extremely durable surface flotation package and an underwater mooring line of instruments and sensors. The apex contains data loggers for meteorological, ice physics and engineering measurements, microcontroller modules for accumulating the data, and ARGOS platform transmit terminals (PTTs) for broadcasting the data. The ocean sensors include conductivity/temperature recorders, an Acoustic Doppler Current Profiler (ADCP), a dissolved oxygen sensor, a transmissometer and two fluorometers. Furthermore, a suspended particle collector and sediment trap collect biogeochemical samples at the bottom of the 110 m suspended mooring. In Apr. 1992, two IOEBs were successfully deployed at two separate ice camps in the Arctic Ocean with battery power adequate to sustain the systems for over two years.

MP 3522

IMPACT OF THE WINTER ENVIRONMENT ON INTRUSION DETECTION SYSTEMS BURIED IN SOIL OR GRAVEL.

Peck, L., 35th annual meeting, Naples, FL, July 17-20, 1994. Proceedings, Northbrook, IL, Institute of Nuclear Materials Management, 1994, p.358-365, 6 refs. 49-1316

WARNING SYSTEMS, DETECTION, SENSORS, UNDERGROUND CABLES, SNOW COVER EFFECT, FROZEN GROUND THERMODYNAMICS, COLD WEATHER PERFORMANCE

Buried intrusion detection systems (IDSs) are commonly employed in soil or gravel, with perhaps a layer of sand surrounding the IDS. The detection capabilities of ground-motion IDSs, such as optical fiber systems and ported coaxial cable IDSs depend on the elastic properties and unfrozen moisture content of the burial media, respectively, which in turn depend on the frozen-unfrozen status of the media. Results of controlled intrusions against ported coaxial cable and optical fiber IDSs are presented to show the magnitude of changes in detection capability associated with the freezeup of the burial media. Numerical simulations of heat transfer and freeze-thaw penetration in soil, done for several moisture contents, show that the presence of a sand layer surrounding the sensor cable is beneficial for ported coaxial cable IDSs. Optical fiber IDSs have better and more consistent detection capability year-round when buried in gravel than in soil.

MP 3523

QUANTITATIVE MODELING OF SOIL FORMING PROCESSES IN DESERTS: THE CALDEP AND CALGYP MODELS.

Marion, G.M., Schlesinger, W.H., Quantitative modeling of soil forming processes. SSSA special publication, No.39, Madison, WI, Soil Science Society of America, 1994, p.129-145, 44 refs. Presented at a symposium, Minneapolis, Nov. 2, 1992. 49-1410

DESERT SOILS, SOIL FORMATION, SOIL CHEMISTRY, SOIL DATING, GEOCHEMICAL CYCLES, WEATHERING, PALEOCLIMATOLOGY

MP 3524

KRMS SSM/ VALIDATION MARCH 1988: QUICK LOOK REPORT.

Farmer, L.D., Eppler, D.T., Heydlauff, B., Olsen, D.A., U.S. Naval Ocean Research and Development Activity. NORDA technical note, Jan. 1989, No.385, 43p., ADA-205 606. 49-1411

ICE SURVEYS, SEA ICE DISTRIBUTION, ICE REPORTING, DRIFT, AERIAL SURVEYS, RADIOLOGY The Ka-band Radiometric Mapping System (KRMS) was flown in support of the NASA SSM/ validation program from Mar. 6-14, 1988. Data were collected on each of four days during this period. This report provides the flight and navigation records required to reconstruct the missions. Flight tracks, compiled from the primary navigation system, indicate areas of coverage. The system logs provide the sensor settings and pertinent flight data, such as altitude and ground speed. The navigation logs provide specifics as to location of data and time of collection. A flight track chart is provided for each day's mission. Several examples of KRMS imagery are also provided.

vide specifics as to location of data and time of collection. A flight track chart is provided for each day's mission. Several examples of KRMS imagery are also provided.

MP 3525

EVALUATION OF THE GEOTHERMAL HEAT PUMP INSTALLATION AT THE NAVAL AIR STATION, PATUXENT RIVER.

Garg, S., Phetteplace, G.E., U.S. Naval Facilities Engineering Service Center. Technical memorandum, Oct. 1994, TM-2093-ENG, 9p. + append., 2 refs. 49-1412

HEAT PUMPS, HEAT TRANSFER, GEOTHERMY, MILITARY FACILITIES

MP 3526

LOW-TEMPERATURE COMPRESSIVE STRENGTH OF GLASS-FIBER-REINFORCED POLYMER COMPOSITES.

Dutta, P.K., Journal of offshore mechanics and arctic engineering, Aug. 1994, Vol.116, p.167-172, 10 refs. 49-1433

CONSTRUCTION MATERIALS, COMPOSITE MATERIALS, POLYMERS, ULTIMATE STRENGTH, COMPRESSIVE PROPERTIES, THERMAL EXPANSION, DEFORMATION, STRESS CONCENTRATION, BRITTLENESS, CRACKING (FRACTURING), LOW TEMPERATURE TESTS

Polymeric composites are relatively inexpensive materials of high strength, in which deformation of the matrix is used to transfer stress by means of shear traction at the fiber-matrix interface to the embedded high-strength fibers. At low temperatures, complex stresses are set up within the microstructure of the material as a result of matrix stiffening and mismatch of thermal expansion coefficients of the constituents of the composites. These stresses in turn affect the strength and deformation characteristics of the composites. This is demonstrated by compression testing of a unidirectional glass-fiber-reinforced polymer composite at room and low temperatures. The increase of compressive strength matched the analytical prediction of strength increase modeled from the consideration of increase in matrix stiffness and thermal residual stresses at low temperatures. Additional compression tests performed on a batch of low-temperature thermally cycled specimens confirmed the predictable reduction of brittleness due to suspected increase of microcrack density.

MP 3527

VENTILATING ATTICS TO MINIMIZE ICINGS AT EAVES.

Tobiasson, W., Buska, J., Greateorex, A., Energy and buildings, 1994, Vol.21, p.229-234, 6 refs. For another version see 48-3860. 49-1609

COLD WEATHER CONSTRUCTION, BUILDINGS, ROOFS, ICICLES, ICE PREVENTION, VENTILATION

In cold regions, icicles and ice dams may develop on roofs that slope to cold eaves. Ventilating the space below the snow-covered roof with outdoor air to create a 'cold' ventilated roof is often an effective way to avoid such problems. Several buildings in northern New York were instrumented to determine how their attic temperature influenced icing. It was observed that problematic icings developed very slowly, if at all, when the outside temperature was above -5.5°C. It appears that icings can be avoided by sizing natural, and if necessary, mechanical attic ventilation systems to maintain an attic temperature of -1°C when the outside temperature is -5.5°C.

MP 3528

PANEL HEATERS USED TO CONTROL ICE GROWTH CAUSED BY FLUCTUATING WATER LEVELS.

Haynes, F.D., Haehnel, R., Zabilansky, L., U.S. Army Corps of Engineers. Waterways Experiment Station. Repair, Evaluation, Maintenance, and Rehabilitation Research Program. REMR bulletin, Apr. 1994, 11(1), p.7-10. 49-1611

LOCKS (WATERWAYS), DAMS, ICE GROWTH, ICE CONTROL, ICE PREVENTION, RADIANT HEATING

MP 3529

HEATED WATER JET FOR MELTING ICE.

Haynes, F.D., U.S. Army Corps of Engineers. Waterways Experiment Station. Repair, Evaluation, Maintenance, and Rehabilitation Research Program. REMR bulletin, Dec. 1993, 10(4), p.12-15, 2 refs. 49-1612

LOCKS (WATERWAYS), DAMS, ICE CONTROL, ICE PREVENTION, ICE REMOVAL, ARTIFICIAL MELTING, HYDRAULIC JETS

MP 3530

PANEL WALL HEATERS SUCCESSFUL AT STARVED ROCK LOCK AND DAM, ILLINOIS RIVER.

Haynes, F.D., U.S. Army Corps of Engineers. Waterways Experiment Station. Repair, Evaluation, Maintenance, and Rehabilitation Research Program. REMR bulletin, Apr. 1994, 11(1), p.11. 49-1613

LOCKS (WATERWAYS), DAMS, ICE CONTROL, ICE PREVENTION, RADIANT HEATING, UNITED STATES—ILLINOIS RIVER

MP 3531

WAVE PROPAGATION IN ICE-COVERED CHANNELS—DISCUSSION.

Steffler, P.M., Hicks, F.E., Daly, S.F., Journal of hydraulic engineering, Dec. 1994, 120(12), p.1478-1480, 2 refs. For paper under discussion see 48-1242. 49-1665

CHANNELS (WATERWAYS), WATER FLOW, ICE COVER EFFECT, ICE WATER INTERFACE, WAVE PROPAGATION, HYDRAULICS, ANALYSIS (MATHEMATICS)

MP 3532

SALINITY VARIATIONS IN WEDDELL SEA PACK ICE.

Ackley, S.F., Gow, A.J., Lytle, V.I., Antarctic journal of the United States, 1993, 28(5), p.79-81, 6 refs. 49-1688

ICE COMPOSITION, PACK ICE, ICE SALINITY, ANTARCTICA—WEDDELL SEA

The 5-month lifetime of Ice Station Weddell 1 (ISW-1) enabled revisits to several sites, and studies were made of the evolution of the salinity distribution in the ice cover. Two figures show core profiles taken from a new ice growth area adjacent to the ISW-1 floe. The two cores were taken within 2 m of each other, 30 days apart on Mar. 13 and Apr. 12, 1992. The cores of first-year ice show behavior at variance with arctic ice of similar age, primarily because of their anomalously high near-surface salinities. This results from an initial thick layer of frazil ice and fast freezing of the resulting ice slurry that apparently both contribute to the high surface salinity. For the second-year ice at ISW-1, the mean salinity falls below that of arctic winter ice, reflecting some transformation during the summer warming.

MP 3533

CLIMATE CORRELATIONS BETWEEN GREENLAND AND ANTARCTICA DURING THE PAST 100,000 YEARS.

Bender, M., et al, Nature, Dec. 15, 1994, 372(6507), p.663-666, 50 refs. 49-1693

ICE CORES, CLIMATIC CHANGES, GEOCHEMISTRY, GEOCHRONOLOGY, ANTARCTICA—VOSTOK STATION Ice cores recovered from central Greenland by the GRIP and GISP2 projects have recorded 22 interstadial (warm) events during the part of the last glaciation spanning 20-105 kyr. The ice core from Vostok, East Antarctica records nine interstadials during this period. Explored here are links between Greenland and antarctic climate during the last glaciation, using a high-resolution chronology derived by correlating oxygen isotope data for trapped O₂ in the GISP2 and Vostok cores. This procedure shows that interstadials occurred in East Antarctica whenever those in Greenland lasted longer than 2,000 years. The results suggest that partial deglaciation and changes in ocean circulation are partly responsible for the climate teleconnection between Greenland and Antarctica. Ice older than 115 kyr in the GISP2 core shows rapid variations in the $\delta^{18}\text{O}$ of O₂ that have no counterpart in the Vostok record. The age-depth relationship, and thus the climate record, in this part of the GISP2 core appears to be significantly disturbed. (Auth. mod.)

MP 3534

USE OF SEWAGE SLUDGE ON PARK AND RECREATIONAL LANDS.

Palazzo, A.J., Iskandar, I.K., Sewage sludge: land utilization and the environment, Madison, WI, American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America (ASA-CSSA-SSSA), 1994, p.101-103, 10 refs. 49-1415

SLUDGES, SEWAGE DISPOSAL, SOIL CONSERVATION, SOIL CHEMISTRY, LAND RECLAMATION, REVEGETATION, NUTRIENT CYCLE

MP 3535

ACCUMULATION RECORD FROM THE GISP2 CORE AS AN INDICATOR OF CLIMATE CHANGE THROUGHOUT THE HOLOCENE.

Meese, D.A., et al, Science, Dec. 9, 1994, 266(5191),

p.1680-1682, 24 refs.

49-1702

ICE CORES, CLIMATIC CHANGES, GEOCHRONOLOGY, GEOCHEMISTRY, GREENLAND

A depth-age scale and an accumulation history for the Holocene have been established on the Greenland Ice Sheet Project 2 (GISP2) deep core, providing the most continuously dated record of annual layer accumulation currently available. The depth-age scale was obtained with the use of various independent techniques to count annual layers in the core. An annual record of surface accumulation during the Holocene was obtained by correcting the observed layer thicknesses for flow-thinning. Fluctuations in accumulation provide a continuous and detailed record of climate variability over central Greenland during the Holocene. Climate events, including "Little Ice Age" type events, are examined.

MP 3536

RECORD OF VOLCANISM SINCE 7000 B.C. FROM THE GISP2 GREENLAND ICE CORE AND IMPLICATIONS FOR THE VOLCANO-CLIMATE SYSTEM.

Zielinski, G.A., et al, *Science*, May 13, 1994, 264(5161), p.948-952, 48 refs.

48-3941

ICE CORES, CLIMATIC CHANGES, VOLCANOES, GEOCHEMISTRY

Sulfate concentrations from continuous biyearly sampling of the GISP2 Greenland ice core provide a record of potential climate-forcing volcanism since 7000 B.C. Although 85% of the events recorded over the last 2000 years were matched to documented volcanic eruptions, only about 30% of the events from 1 to 7000 B.C. were matched to such events. Several historic eruptions may have been greater sulfur producers than previously thought. There are three times as many events from 5000 to 7000 B.C. as over the last two millennia with sulfate deposition equal to or up to five times that of the largest known historical eruptions. This increased volcanism in the early Holocene may have contributed to climatic cooling.

MP 3537

DEPENDENCE OF SEGREGATION POTENTIAL ON THERMAL AND HYDRAULIC CONDITIONS PREDICTED BY MODEL M₁

Nakano, Y., International Symposium on Ground Freezing, 7th, Nancy, France, Oct. 24-28, 1994. Proceedings. Ground Freezing 94. Edited by M. Frémond, Rotterdam, A.A. Balkema, 1994, p.25-33, 25 refs.

49-1723

SOIL FREEZING, ICE LENSES, FREEZING FRONT, FROST HEAVE, FROST FORECASTING, FROZEN GROUND THERMODYNAMICS, SOIL WATER MIGRATION, MATHEMATICAL MODELS

The widely used segregation potential (SP) model is semiempirical in nature. An accurate mathematical model is needed that provides the functional dependence of SP on pertinent variables specifying given thermal and hydraulic conditions in terms of well-defined functions (or parameters) describing the properties of a given soil. In response to such need a mathematical model called M₁ was introduced and efforts have been made to validate M₁ by empirical findings and experimental data. In this paper it is shown that the functional dependence of SP on pertinent variables predicted by M₁ is consistent with empirical findings that were used to build the SP model.

MP 3538

CREEP STRENGTH OF OTTAWA FROZEN SAND UNDER VARYING MEAN STRESS.

Fish, A.M., International Symposium on Ground Freezing, 7th, Nancy, France, Oct. 24-28, 1994. Proceedings. Ground Freezing 94. Edited by M. Frémond, Rotterdam, A.A. Balkema, 1994, p.103-108, 14 refs.

49-1735

FROZEN GROUND STRENGTH, FROZEN GROUND COMPRESSION, SOIL CREEP, SANDS, SOIL TESTS, STRAIN TESTS, MATHEMATICAL MODELS

Studies were carried out on the creep strength of Ottawa fine sand at -3.89 C under triaxial compression. The time-dependent strength of the frozen soil under multiaxial stress state is described by a parabolic creep strength criterion. In the particular case of the small stress domain, the parabolic yield criterion transforms into a generalized (for creep conditions) Drucker-Prager strength criterion. The latter, which was originally developed by the author to describe the strength of frozen soil when mean normal stress was constant, is expanded in the paper over a stress state at which the mean normal stress changes with time in accordance with the curve of the long-term strength (time-dependent failure). It is shown that if the rheological parameters of frozen soil are known, the above criterion describes the long-term strength of soil under a multiaxial stress state at constant and varying mean stress.

MP 3539

HETEROGENETIC AND SYNGENETIC GROWTH OF PERMAFROST.

Lunardini, V.J., International Symposium on Ground Freezing, 7th, Nancy, France, Oct. 24-28, 1994. Proceedings. Ground Freezing 94. Edited by M. Frémond, Rotterdam, A.A. Balkema, 1994, p.361-373, 32 refs.

49-1770

PERMAFROST ORIGIN, PERMAFROST DATING, PERMAFROST FORECASTING, PERMAFROST HEAT BALANCE, PERMAFROST THERMAL PROPERTIES, PALEOCLIMATOLOGY, MATHEMATICAL MODELS

The growth of permafrost is an example of the freeze to a great depth of a semi-infinite medium with an initial temperature gradient, a lower boundary heat flow, and a prescribed surface temperature. This thermal problem for a conduction system with surface deposition is solved approximately with the heat balance integral technique. The appropriate surface temperature is chosen by examining known or ice-core-deduced paleotemperatures for specific locations. Graphs are presented allowing predictions to be made for a variety of typical permafrost or frozen ground examples.

MP 3540

PHYSICAL CONTROLS ON THE DEVELOPMENT AND CHARACTERISTICS OF ANTARCTIC SEA ICE BIOLOGICAL COMMUNITIES—A REVIEW AND SYNTHESIS.

Ackley, S.F., Sullivan, C.W., *Deep-sea research pt. I*, 1994, 41(10), p.1583-1604, Refs. p.1600-1604.

49-1792

MARINE BIOLOGY, BIOMASS, ALGAE, ECOSYSTEMS, SEA ICE, PACK ICE, ICE MICROSTRUCTURE, ICE GROWTH, CLASSIFICATIONS, ICE COVER EFFECT, ICE WATER INTERFACE, ANTARCTICA—WEDDELL SEA, ANTARCTICA—ROSS SEA

Ice structures found in antarctic sea ice and related morphological processes are summarized, including frazil ice growth; the flooded snow layer; pressure ridge induced flooding; thermally driven brine drainage; and platelet-ice formation. The associated colonization, physiological adaptation, and growth of sea ice biota within these structures, to the levels presently identifiable, are also reviewed. Variability of ice structure and associated biological communities over small spatial scales necessitated analysis of the biological component in combination with physical and chemical properties of the sea ice. The ice microstructure provides indications of the growth and evolution of ice properties and initially defines how ice biota colonize the ice. While the ice microstructure shapes the localized biological response, relatively large regions of pack ice have characteristic microstructures. Regional patterns of biomass and biological productivity within the antarctic sea ice zone may therefore be predictable as a result of these physical-biological associations. Examples from the drifting pack ice and fast ice zones of the Weddell and Ross Seas are given. (Auth. mod.)

MP 3541

DESIGN DATA OF COMPOSITE MATERIALS FOR COLD REGIONS ENVIRONMENTS.

Dutta, P.K., International Symposium on Composite Materials and Structures, 2nd, Beijing, Aug. 3-7, 1992 (ISCMS/II). Abstracts of paper for work-in-progress, Beijing, [1992], p.5-6.

49-1827

COMPOSITE MATERIALS, COLD WEATHER PERFORMANCE, FROST RESISTANCE, THERMAL STRESSES

MP 3542

DYNAMIC STRESSES IN COMPOSITES AT LOW TEMPERATURES.

Dutta, P.K., Dynamic Response of Composite Structures Workshop, New Orleans, Aug. 30-Sep. 1, 1993, Research Triangle Park, NC, U.S. Army Research Office, [1993], 2p.

49-1828

COMPOSITE MATERIALS, POLYMERS, COLD WEATHER PERFORMANCE, COLD STRESS, STRAIN TESTS

MP 3543

CHARACTERIZATION OF COMPOSITE MATERIALS BY VERTICAL DYNAMIC HOPKINSON BAR.

Nwosu, S.N., Dutta, P.K., Hui, D., Integrated design and manufacturing of composites, New York, American Society of Mechanical Engineers, 1994, p.141-151, 12 refs.

49-1829

COMPOSITE MATERIALS, IMPACT STRENGTH, IMPACT TESTS, MECHANICAL TESTS, TEST EQUIPMENT

A single Vertical Dynamic Hopkinson Bar (VDHB) is introduced for the characterization of composite materials by stress reflectance of the waveforms. The incident stress wave is generated in a vertical bar from longitudinal vertical impact of a steel impac-

tor. The results show a correlation between the mechanical wave stress reflectance and the material impedances. Of the graphite epoxy, fiber reinforced plastics, rubber and foam materials tested, the graphite epoxy had the highest stress reflectance.

MP 3544

COLLECTION AND CURATION OF IDPS FROM THE GREENLAND AND ANTARCTIC ICE SHEETS.

Maurette, M., Immel, G., Hammer, C., Harvey, R., Kurat, G., Taylor, S., Analysis of Interplanetary Dust Workshop, Houston, May 1993. AIP conference proceedings, No.310, New York, American Institute of Physics, 1994, p.277-289, 28 refs.

49-1831

ICE SHEETS, ICE COMPOSITION, IMPURITIES, COSMIC DUST

Upon melting or sublimating, Greenland and antarctic ice yields a sandy material which is very rich (up to about 10% by weight in the 50-100 micron size fraction) in unmelted and partially melted micrometeorites (called MMs for micrometeorite or IDPs for interplanetary dust particles). These polar micrometeorites are remarkably unweathered despite having lost unknown amounts of soluble sulfates and carbonates and having "accreted" some trace elements during their settling time in the Earth's atmosphere. Although they mainly bear similarities with the rare class of CM and CR chondrites, some of the characteristics of their primary minerals strongly suggest that they are composed of a material not yet represented in meteorite collections. This paper describes improved methods for collecting micrometeorites in Greenland and Antarctica, and ways to study the past variations of the micrometeorite flux over a time scale >200,000 years.

MP 3545

DISPERSION BY CHEMICAL REACTION TREATMENT OF ASPHALT TAR.

Marion, G.M., Brar, G.S., Payne, J.R., Stanka, M.A., HTRW Innovative Technology Transfer Workshop, 4th, Omaha, July 19-22, 1994, U.S. Army Corps of Engineers, [1994], 2p.

49-1832

OIL SPILLS, OIL RECOVERY, SOIL POLLUTION, SOIL CHEMISTRY, LAND RECLAMATION

MP 3546

POLARIMETRIC BACKSCATTERING FROM THIN SALINE ICE RELATED TO ICE PHYSICAL AND MORPHOLOGICAL CHARACTERISTICS.

Nghiem, S.V., et al, International Geoscience and Remote Sensing Symposium, Pasadena, CA, Aug. 8-12, 1994. Proceedings, Vol.1, Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1994, p.541-543, 8 refs.

49-1883

SEA ICE, ICE PHYSICS, PHYSICAL PROPERTIES, ELECTROMAGNETIC PROPERTIES, WAVE PROPAGATION, ATTENUATION, BACKSCATTERING, SURFACE ROUGHNESS, MATHEMATICAL MODELS

A model for polarimetric backscattering from thin saline ice, including volume and surface scattering mechanisms, is used to relate ice physical and morphological characteristics to the backscattering signatures obtained under controlled laboratory conditions. The model is based on the analytic wave theory and accounts for ellipsoidal brine inclusions, c-axis orientations, rough interfaces, vertical anisotropy, and permittivity tensor determined with brine volume governed by thermodynamic phase equations during the process of ice growth. A brine or slush cover layer is modelled in a layered configuration as a lossy layer with large permittivity magnitude due to the high salinity. The contribution to backscattering from rough interfaces is included with consideration of wave attenuation and phase difference effect in the anisotropic ice media.

MP 3547

EXPERIMENTAL STUDY OF RELATIVE CONTRIBUTIONS FROM SURFACE AND VOLUME SCATTERING MECHANISMS IN SALINE ICE.

Bredow, J.W., et al, International Geoscience and Remote Sensing Symposium, Pasadena, CA, Aug. 8-12, 1994. Proceedings, Vol.1, Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1994, p.608-610, 2 refs.

49-1887

SEA ICE, ICE OPTICS, ELECTROMAGNETIC PROPERTIES, RADAR ECHOES, SCATTERING, SURFACE ROUGHNESS, ALBEDO, SIMULATION, MATHEMATICAL MODELS

A randomly rough surface with Gaussian height distribution and a Gaussian correlation function was manufactured as a good conducting mold to generate a thin ice layer with the same surface geometry. This ice layer was superimposed on a thick smooth saline ice with known salinity property to form a saline ice medium with a known air-ice roughness characteristic. Multifrequency radar backscattering measurements were taken at C

through X bands on the mold itself, and at X through Ku bands on the smooth saline ice medium before and after adding the rough ice boundary. Measurements of the mold were made to establish a reference for scattering. The objective of the ice measurements is to establish the contribution from surface roughness alone from the smooth saline ice, before and after adding roughness, so that a clear understanding is achieved regarding the roles of surface and volume scattering and how these two mechanisms combine to total scattering from an inhomogeneous medium with irregular boundary. Results indicate that surface scattering dominates at small angles of incidence and its range of dominance decreases with increase in frequency. This happens because the increase in volume scattering due to larger albedos exceeds the increase in surface scattering as frequency increases.

MP 3548

POLARIMETRIC BACKSCATTERING SIGNATURES FROM THIN SALINE ICE UNDER CONTROLLED LABORATORY CONDITIONS.

Nghiem, S.V., et al, International Geoscience and Remote Sensing Symposium, Pasadena, CA, Aug. 8-12, 1994. Proceedings, Vol.1, Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1994, p.611-613, 3 refs.

49-1888

SEA ICE, YOUNG ICE, ELECTROMAGNETIC PROPERTIES, ICE COVER THICKNESS, REMOTE SENSING, MICROWAVES, BACKSCATTERING, POLARIZATION (WAVES), SIMULATION

An experiment was conducted to measure polarimetric backscattering signatures from thin ice at the U.S. Army Cold Regions Research and Engineering Laboratory. The purpose of the experiment is to provide data for understanding scattering mechanisms in sea ice in order to develop models relating polarimetric signatures to physical, morphological, and electromagnetic properties of sea ice. Saline ice was grown in an indoor pit with the air temperature kept about -20°C to simulate the cold arctic condition. During ice growth, a C-band polarimetric scatterometer was used to acquire backscattering matrices as functions of incident angles for ice thicknesses up to 12 cm. Also investigated were polarimetric signatures of thin ice under various modified conditions including frost flower, ice warming, surface flooding, and slush layer. Ice characterization parameters and samples were collected to relate ice properties to the microwave polarimetric signatures. (Auth. mod.)

MP 3549

MODELING INTERPRETATION OF SCATTERING FROM SNOW-COVERED SEA ICE.

Fung, A.K., et al, International Geoscience and Remote Sensing Symposium, Pasadena, CA, Aug. 8-12, 1994. Proceedings, Vol.1, Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1994, p.617-619, 3 refs.

49-1890

SEA ICE, REMOTE SENSING, RADAR ECHOES, SCATTERING, POLARIZATION (WAVES), SURFACE ROUGHNESS, ALBEDO, SNOW COVER EFFECT, MATHEMATICAL MODELS

Radar scattering measurements of saline ice at 5.3 and 13.4 GHz were collected during the '90 and '92 winter seasons at the U.S. Army Cold Regions Research and Engineering Laboratory. Both like- and cross-polarizations were obtained from saline ice with and without snow cover. Measurements were examined with a radiative transfer model applied to inhomogeneous layers with densely populated discrete scatterers. It is found that bare saline ice has a low albedo and hence its like-polarized backscattering is dominated by the irregular air-ice interface over 10 to 50 degs. For cross-polarized scattering, volume scattering effect is also small compared with surface scattering. When there is snow cover, there is a general increase in scattering along nonspecular directions. This is attributed to the brine wicking effect which causes a higher concentration of brine along the interface region and a possible roughening of the snow-ice interface.

MP 3550

ANALYSIS OF SURFACE-BASED PASSIVE MICROWAVE OBSERVATIONS DURING LEADDEX 1992.

Grenfell, T.C., Perovich, D.K., International Geoscience and Remote Sensing Symposium, Pasadena, CA, Aug. 8-12, 1994. Proceedings, Vol.2, Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1994, p.1005-1007, 5 refs.

49-1898

SEA ICE DISTRIBUTION, ICE OPENINGS, REMOTE SENSING, RADIOLOGY, MICROWAVES, BRIGHTNESS, YOUNG ICE, ICE GROWTH, FRAZIL ICE, POLARIZATION (WAVES)

The concentration and thickness of new and young sea ice are of interest in understanding the heat and mass balance of the polar oceans. Heat and salt exchange processes in thin ice areas are one to two orders of magnitude more vigorous than in areas of thick first-year (FY) and multiyear ice. A small amount of new ice production (1-5%) can therefore have a substantial effect on the regional energy balance. Due to the logistical difficulties in

observing thin ice in the polar regions, most of the information on the development of passive microwave signatures of thin sea ice has been obtained from experiments on ice grown in a pond at the Cold Regions Research and Engineering Laboratory in Hanover, NH. An experiment dedicated to studying the properties of sea ice growing in Arctic leads (LEADDEX '92) was carried out during Mar. and Apr. 1992 in the southern Beaufort Sea about 160 km north of Prudhoe Bay, AK. The authors participated in this effort in order to obtain passive microwave observations of thin sea ice growing under natural conditions.

MP 3551

REVIEW OF MODELING FOR MILLIMETER WAVE REMOTE SENSING OF SNOW.

O'Neill, K., International Geoscience and Remote Sensing Symposium, Pasadena, CA, Aug. 8-12, 1994. Proceedings, Vol.4, Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1994, p.1925-1928, 37 refs.

49-1937

SNOW PHYSICS, SNOW COVER STRUCTURE, MICROSTRUCTURE, REMOTE SENSING, RADAR ECHOES, SURFACE ROUGHNESS, SCATTERING, MODELS

Millimeter wave sensing presents new problems and prospects in relation to snow. Recognition of the importance and measurement of the particulars of snowpack microstructure challenges traditional modeling approaches. Simulation methods are examined in relation to the demands of millimeter wave sensing. Distinctive features and critical issues include treatment of near-surface microstructure, medium anisotropy and density, polarization effects, moisture content, and multi-scale surface roughness.

MP 3552

EFFECT OF SNOW STEREOLOGY ON MILLIMETER WAVE EXTINCTION.

Koh, G., Davis, R.E., International Geoscience and Remote Sensing Symposium, Pasadena, CA, Aug. 8-12, 1994. Proceedings, Vol.4, Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1994, p.1929-1931, 7 refs.

49-1938

SNOW PHYSICS, SNOW DENSITY, MICROSTRUCTURE, REMOTE SENSING, RADAR ECHOES, SCATTERING, ATTENUATION, RADIATION ABSORPTION, SIMULATION

A network analyzer based system was used to measure the extinction coefficient of various snow types at 26.5 to 40 GHz under controlled laboratory conditions. The snow samples were prepared using sieved snow so that the physical properties of the snow could be extensively characterized. By using sieved snow, it was possible to vary and to measure the size distribution of the disaggregated ice particles making up the snow sample. In addition, snow stereochemistry measurements were made to obtain the microstructural properties of the snow samples. These results were then used to identify the key snow pack parameters that are required to determine the extinction behavior of a snow pack at the radar frequencies.

MP 3553

DETAILED STUDY OF THE BACKSCATTER CHARACTERISTICS OF SNOWCOVER MEASURED AT 35, 95 AND 225 GHz.

Chang, P., Mead, J.B., McIntosh, R.E., Davis, R., Boyne, H., International Geoscience and Remote Sensing Symposium, Pasadena, CA, Aug. 8-12, 1994. Proceedings, Vol.4, Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1994, p.1932-1934, 9 refs.

49-1939

SNOW COVER STRUCTURE, CLASSIFICATIONS, REMOTE SENSING, RADAR ECHOES, BACKSCATTERING, MICROSTRUCTURE, ANISOTROPY, METAMORPHISM (SNOW)

This paper presents 35, 95 and 225 GHz polarimetric backscatter data from snowcover. It compares measured backscatter data with detailed *in situ* data measurements of the snowcover including microstructural anisotropies within the snowpack. Observations of radar backscatter at 35, 95 and 225 GHz were made during melt-freeze cycles, and measurable differences in the normalized radar cross-section between older metamorphic snow and fresh low density snow were observed. Further polarimetric measurements show that the average phase difference between the co-polarized terms of the scattering matrix is nonzero for certain snow types. These measurements are explained by the effects that the microstructure of the snow has on propagation within the snowpack. A simple vector radiative transfer model that includes the propagation effects is seen to predict the Mueller matrix for dry snowcover reasonably well.

MP 3554

ANALYSIS OF REAL INFRARED SCENES ACQUIRED FOR SVOE JT&E.

Bleiweis, M.P., Rollins, M., Chaapel, C., Berger, R., International Geoscience and Remote Sensing Symposium, Pasadena, CA, Aug. 8-12, 1994. Proceedings, Vol.4, Piscataway, NJ, Institute of Electrical and Elec-

tronics Engineers, Inc., 1994, p.2101-2105, 14 refs.

49-1954

REMOTE SENSING, GEOPHYSICAL SURVEYS, TERRAIN IDENTIFICATION, IMAGING, IMAGE PROCESSING, INFRARED PHOTOGRAPHY, RADIOLOGY

An ensemble of terrain images from forested and semiarid environments are analyzed in terms of first- and second-order textural statistics and Fourier and wavelet transform metrics. Such parameters are sought in an effort to reduce the dimensionality of terrain image information to suitable levels of both generality and specificity. By developing a practical set of feature metrics, a real and generated scene can be compared critically in terms of scene elements rather than pixel-to-pixel error. This paper presents some of the results of such a validation process for the Smart Weapons Operability Enhancement Joint Test and Evaluation program. Statistical and transform-based techniques were applied to terrain images obtained at various times of day under a variety of weather conditions. Statistical analyses of scene radiance distributions and "clutter" content were performed both spatially and temporally. An emphasis on the spatial and temporal distinction between widely distributed terrain features (grass, dirt) and discrete features (trees, bushes) is made.

MP 3555

ANTARCTIC SEA ICE PASSIVE MICROWAVE SIGNATURES DURING SUMMER AND AUTUMN.

Comiso, J.C., Ackley, S.F., International Geoscience and Remote Sensing Symposium, Pasadena, CA, Aug. 8-12, 1994. Proceedings, Vol.1, Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1994, p.143-146, 10 refs.

49-1859

SEA ICE DISTRIBUTION, ICE CONDITIONS, CLASSIFICATIONS, SEASONAL VARIATIONS, REMOTE SENSING, RADIOLOGY, SYNTHETIC APERTURE RADAR, BRIGHTNESS, ANTARCTICA—WEDDELL SEA

The microwave signatures of antarctic sea ice during the summer and autumn of 1992 are examined using SSM/I data in conjunction with ERS-1 SAR data and observations from an ice station in the western Weddell Sea region. The period from Feb. through Apr. is observed to be critical in terms of monitoring sea ice cover with passive microwave sensors because of surface effects (e.g. melt, slush and flooding) that may cause large fluctuations in the signature of sea ice during the period. Ice concentrations calculated using reference brightness temperatures normally used for winter data are considerably lower than those observed in the field and those derived from SAR data. Reference temperatures more appropriate for the summer ice data were inferred and provided more compatible ice concentrations. In late summer and autumn, freezing conditions begin to dominate and the brightness temperatures of sea ice, still different from those of winter, reflect those primarily of refrozen slush over thick ice, young ice, and new ice.

MP 3556

SUMMARY REPORT.

Antarctic Traverse Workshop, Washington, D.C., May 2-4, 1994, Melendy, R., ed, Blaisdell, G.L., ed, Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, 1994, Var. p.

49-1969

TRAVERSES, LOGISTICS, ROUTE SURVEYS, SNOW VEHICLES, TRACKED VEHICLES, TRACTORS, CREVASSE DETECTION, ANTARCTICA

The main focus of this workshop was on heavy hauling oversnow for supply of inland stations rather than on short, light traverses for purely scientific purposes. The attendees were from Argentina, Australia, Canada, France, Germany, Italy, Norway, Russia, South Africa, Sweden, the United Kingdom, and the United States. There were no written proceedings. Most of the text consists of handouts and overhead slides. Topics of discussion include traverse experiences; route selection; crevasse detection; and equipment, in particular, caterpillar tractors, caterpillar trailers, and sleds.

MP 3557

GISP ICE CORE RECORD OF VOLCANISM SINCE 7,000 B.C.

Fiedel, S.J., Southon, J.R., Brown, T.A., Zielinski, G.A., *Science*, Jan. 13, 1995, 267(5195), p.256-258, 23 refs.

49-1990

ICE CORES, VOLCANOES, GEOCHRONOLOGY, GREENLAND

Fiedel, Southon and Brown comment on Zielinski's paper which appeared in *Science* on May 13, 1994 and is identified in the CRREL Bibliography as 48-3941. Zielinski et al respond.

MP 3558

LONG-TERM RECOVERY OF VEGETATION ON TWO EXPERIMENTAL CRUDE OIL SPILLS IN INTERIOR ALASKA BLACK SPRUCE TAIGA.

Racine, C.H., *Canadian journal of botany*, 1994,

Vol. 72, p.1171-1177, 22 refs.

49-2055

SUBARCTIC LANDSCAPES, TAIGA, ECOSYSTEMS, REVEGETATION, CRUDE OIL, OIL SPILLS, ENVIRONMENTAL IMPACT, ENVIRONMENTAL TESTS, VEGETATION PATTERNS, TREES (PLANTS), UNITED STATES—ALASKA

Vegetation was sampled on two black spruce taiga sites in interior Alaska, 15 and 20 years after crude oil was experimentally applied as low-volume sprays or high-volume point spills. Low volume spray spills that uniformly covered the ground caused initial damage to vegetation, but after 20 years recovery of the understory, vegetation was almost complete, with dramatic recovery and expansion of fruticose lichens. High-volume point spills created small areas of surface oil saturation with dead vegetation and little sign of recovery but spread out mostly below ground with little or no apparent effect on the shallowly rooted vegetation above even after 15-20 years. At both sites with surface oil, black spruce mortality was high, with no evidence of long-term recovery and with continuing chronic effects after 15 years. However, from a long-term perspective the black spruce taiga ecosystem appears to be able to recover from low volume spray spills and to retain large amounts of crude oil from high-volume point spills below ground with minimal damage to the vegetation. Because of the permafrost, removal of crude oil from this ecosystem by soil excavation is undesirable. *In situ* acceleration of oil breakdown using fertilizers and bacteria is a possible option; seeding or planting of *E. vaginatum* on surface-oiled areas may also provide some cover and below ground biomass.

MP 3559

GROUNDWATER-DISCHARGE FENS IN THE TANANA LOWLANDS, INTERIOR ALASKA, U.S.A.

Racine, C.H., Walters, J.C., *Arctic and alpine research*, Nov. 1994, 26(4), p.418-426, 27 refs.

49-2198

SUBARCTIC LANDSCAPES, WETLANDS, CHANNELS (WATERWAYS), GROUND WATER, UPWELLING, HYDROLOGY, PLANT ECOLOGY, ECOSYSTEMS, CLASSIFICATIONS, VEGETATION PATTERNS, UNITED STATES—ALASKA—TANANA FLATS

Large expanses of herbaceous floating mat wetlands (FMW) bordered by slightly higher uplands with forest or scrub occur in the northwest corner of the Tanana Flats between the Alaska Range and the Tanana River. The floating mat vegetation consists of tall emergent macrophytes; mosses are conspicuously absent and shrubs are infrequent. Although species dominance shifts over short distances on the mat, four community types can be recognized: (1) *Menyanthes trifoliata*, (2) *Carex aquatilis*, (3) *Typha latifolia*, and (4) *Calla palustris*. Below the water surface, the mat extends to a depth of 0.5 to 1.0 m and consists of rhizomes and roots in a matrix of well-decomposed peat and water. The mat then either directly overlies unfrozen gray silts at a depth of 1 m, or more commonly, floats on a clear-water or loose peat zone above more consolidated peat lying on unfrozen silt at a depth of 1.5 to 2.5 m. No permafrost or frozen ground was detected in late Aug. or late winter below these floating mats, but it is ubiquitous on the bordering uplands, 0.5 to 2 m above the FMW. The topographic location, apparent absence of permafrost, water chemistry, and vegetation composition all suggest that these areas are fens fed by groundwater sources flowing out of the Alaska Range. Although floating mats are frequently described in the literature as occupying the edge of northern ponds and lakes, the FMW described here do not; they appear to be unique because of their large extent, absence of mosses, physiographic position, and presumed origin.

MP 3560

HEAT FLUX TRANSDUCERS MEASURE *IN-SITU* BUILDING THERMAL PERFORMANCE.

Flanders, S.N., *Journal of thermal insulation and building envelopes*, July 1994, Vol.18, p.28-52, 30 refs.

49-2199

BUILDINGS, THERMAL INSULATION, HEAT FLUX, TEMPERATURE MEASUREMENT, STANDARDS

This paper presents an overview of heat flux transducers (HFTs) used for *in-situ* measurements of building performance. HFTs that are mounted in laboratory testing apparatuses are beyond the scope of the paper. The overview is based on HFT literature from the past five years. The overview covers how HFTs are constructed to measure heat flow and touches on the near relatives of HFTs, portable calorimeters and thermal probes. The question of calibration is key to the appropriate use of HFTs. The paper discusses the range of building thermal performance applications for HFTs, from roofs to foundations to mechanical systems. A variety of ASTM (American Society for Testing and Materials) standards exist that relate to characterizing the building thermal context the HFT is used in. They pertain to: using thermography; HFT measurements; calculating thermal resistance from *in-situ* data; and calibrating the HFT. The author discusses key elements to consider in the use of HFTs for *in-situ* measurements and addresses current developments in the construction and use of HFTs.

MP 3561

POTENTIAL ROLE OF NATURAL ATTENUATION IN REMEDIATING CONTAMINATED SOILS AT COLD REGION MILITARY INSTALLATIONS.

Currier, P.M., Reynolds, C.M., Grant, S.A., Annual Army Environmental R&D Symposium, 17th, and USACE Innovative Technology Transfer Workshop, 3rd, Williamsburg, VA, June 22-24, 1993, Fort Belvoir, VA, U.S. Army Corps of Engineers, [1993], 6p., 2 refs.

49-2200

SOIL POLLUTION, SOIL CHEMISTRY, SOIL MICROBIOLOGY, LAND RECLAMATION, OIL SPILLS, WASTE TREATMENT, MILITARY FACILITIES

Technology continually reduces the cost of treating contaminated soils, yet estimates of the amount of soil requiring treatment are continuously increasing. It now appears inevitable that the resources available will be insufficient to treat all contaminated soils. Generally, contaminants in soil are attenuated to some extent by natural processes. Preliminary information from bioremediation studies and site investigations in Alaska indicate significant variability in reduction of oil contamination when no active or engineered measures are applied. Processes for remediating organic contamination in soil are the same whether the remediation is engineered or natural. In engineered remediation, one to several processes are enhanced by controlling the limiting factors. Engineered solutions are often favored due to the control of transport and transformation processes that can be attained.

MP 3562

ELECTRICAL CHARGING OF SKIS GLIDING ON SNOW.

Colbeck, S.C., *Medicine and science in sports and exercise*, 1995, 27(1), p.136-141, 10 refs.

49-2335

SKIS, SLIDING, SNOW ELECTRICAL PROPERTIES, ELECTRIC CHARGE, CHARGE TRANSFER, PLASTICS, SNOW FRICTION, ICE SOLID INTERFACE, MELT WATER, ELECTRICAL MEASUREMENT, DIELECTRIC PROPERTIES

Ski charging was measured using giant-slam style skis as gliding capacitors. The voltage measured across the plates was proportional to the charge on the base. While resting on dry snow or suspended in the air, the voltage was slowly reduced by the data logger itself. On wet snow the decay was much faster. While stationary on powder snow the ski developed a slightly negative voltage, showed a small transient positive peak when motion began, rapidly dropped to negative values, and then assumed a quasi-steady climb to positive voltages. A great deal of noise was superimposed on the general features of the signal when skiing on hard or bumpy surfaces. The accumulation of charge to high levels was only possible with long runs in deep powder. The rate of charging increased with speed but was not affected by use of one "antistatic" wax, and another such wax actually increased the measured voltage over that of an unwaxed base.

MP 3563

ARCTIC RESEARCH OF THE UNITED STATES, VOL.8.

U.S. Interagency Arctic Research Policy Committee, Myers, C.E., ed, Cate, D.W., ed, Valliere, D.R., ed, Arlington, VA, U.S. National Science Foundation, Office of Polar Programs, Fall 1994, 143p.

49-2356

RESEARCH PROJECTS, ORGANIZATIONS, INTERNATIONAL COOPERATION, REGIONAL PLANNING, MEETINGS, COST ANALYSIS

MP 3564

WINTER STREAM MORPHOLOGY ON THE NORTH SLOPE OF ALASKA.

Chacho, E.F., Jr., Arcone, S.A., Delaney, A.J., *Canada. National Hydrology Research Institute. Subcommittee on Hydraulics of Ice Covered Rivers. NHRI symposium*, 1994, No.12, Workshop on Environmental Aspects of River Ice, Saskatoon, Saskatchewan, Aug. 18-20, 1993. Proceedings. Edited by T.D. Prowse, p.1-2, Abstract only.

49-2358

RIVER ICE, ICE COVER EFFECT, ICE WATER INTERFACE, RIVER FLOW, TALIKS BENEATH RIVERS, UNITED STATES—ALASKA—NORTH SLOPE

MP 3565

RIVERBANK CONDITIONS AND EROSION IN WINTER.

Gatto, L.W., *Canada. National Hydrology Research Institute. Subcommittee on Hydraulics of Ice Covered Rivers. NHRI symposium*, 1994, No.12, Workshop on Environmental Aspects of River Ice, Saskatoon, Saskatchewan, Aug. 18-20, 1993. Pro-

ceedings. Edited by T.D. Prowse, p.43-56, 22 refs.

49-2361

RIVER ICE, ICE COVER EFFECT, ICE EROSION, WATER EROSION, SOIL EROSION, BANKS (WATERWAYS)

Winter in cold climates is a season when some of the well-documented processes that contribute to riverbank erosion have either slowed or are inactive. However, numerous field observations show that bank erosion does not cease during the winter. If the freezing and thawing, ground ice processes and river ice actions do not directly remove bank soils, they can individually or collectively disturb the soils sufficiently to make them more susceptible to erosion by processes that are active during other seasons. Thus, year-round measurements are needed to determine the seasonal extent of erosion, including the quantitative effects of winter factors. Only from such studies will we improve the current inadequate capability to predict riverbank recession.

MP 3566

IMPACTS OF MISSOURI RIVER MAINSTEM DAMS ON THE ICE REGIME OF TRIBUTARY STREAMS.

Wuebben, J.L., *Canada. National Hydrology Research Institute. Subcommittee on Hydraulics of Ice Covered Rivers. NHRI symposium*, 1994, No.12, Workshop on Environmental Aspects of River Ice, Saskatoon, Saskatchewan, Aug. 18-20, 1993. Proceedings. Edited by T.D. Prowse, p.57-58, Abstract only.

49-2362

RIVER ICE, ICE COVER EFFECT, ICE JAMS, FLOOD FORECASTING, FLOOD CONTROL, DAMS

MP 3567

ICE MOTION DETECTOR: ADVANCE WARNING FOR BREAKUP.

Zufelt, J.E., Tuthill, A.M., *Canada. National Hydrology Research Institute. Subcommittee on Hydraulics of Ice Covered Rivers. NHRI symposium*, 1994, No.12, Workshop on Environmental Aspects of River Ice, Saskatoon, Saskatchewan, Aug. 18-20, 1993. Proceedings. Edited by T.D. Prowse, p.59-74, 2 refs.

49-2363

RIVER ICE, ICE BREAKUP, ICE JAMS, ICE DETECTION, ICE FORECASTING, FLOOD FORECASTING, WARNING SYSTEMS

Ice jams in the northern United States result in over \$125 million in damages annually, and the figure for Canada is equally high. In communities where ice jamming and flooding are a recurrent threat, measures are often taken to predict the occurrence of ice jams and minimize their impact. Advance warning that an ice run has actually begun and that flooding is possible can allow downstream communities to evacuate flood-prone areas, close bridges, and mobilize flood-fighting efforts in a timely manner. Present methods of ice run detection rely on either direct around-the-clock river observations, monitoring of stage gauges, or air temperature and precipitation forecasts. An ice run observation provides definite evidence that an ice run has begun but, due to personnel costs, it is often economically prohibitive. Direct observation is also difficult or impossible during nighttime hours. The other two methods merely indicate a probability that breakup can occur and require a thorough knowledge of the river basin and ice processes. This paper describes an inexpensive, automated, around-the-clock ice motion detection system developed at USACRREL that provides a definite indication of ice breakup. Two variations of system configuration and the results obtained over two breakup seasons are presented.

MP 3568

GROUNDWATER HEAT FLUX INTO A SMALL HEADWATER STREAM DURING THE WINTER.

Calkins, D.J., Shanley, J., *Canada. National Hydrology Research Institute. Subcommittee on Hydraulics of Ice Covered Rivers. NHRI symposium*, 1994, No.12, Workshop on Environmental Aspects of River Ice, Saskatoon, Saskatchewan, Aug. 18-20, 1993. Proceedings. Edited by T.D. Prowse, p.75-88, 4 refs.

49-2364

RIVER ICE, ICE COVER EFFECT, ICE WATER INTERFACE, GEOTHERMAL THAWING, HEAT FLUX, STREAMS, GROUND WATER, WATER TEMPERATURE

Water temperatures during the winter period in small headwater streams can remain above the freezing point for a major portion of the time, even if a snow or ice cover exists over the channel. Two factors are primarily responsible: the air gap that develops between the bottom of the ice/snow cover and the water surface and the thermal energy from groundwater inflow. The data analyzed included longitudinal stream temperature profiles under different winter conditions and selected on flow and temperature data at two weirs. The thermal energy flux from a groundwater source in one stream was calculated to be in the order of 40-60 W/m², significantly higher than possible values of frictional heating or streambed conduction.

MP 3569

FRAZIL FLOE STRENGTH MEASUREMENTS: PRELIMINARY TESTS.

White, K.D., *Canada. National Hydrology Research Institute. Subcommittee on Hydraulics of Ice Covered Rivers. NHRI symposium, 1994, No.12, Workshop on Environmental Aspects of River Ice, Saskatoon, Saskatchewan, Aug. 18-20, 1993. Proceedings.* Edited by T.D. Prowse, p.145-159, 4 refs. 49-2368

RIVER ICE, FRAZIL ICE, ICE GROWTH, ICE CRYSTAL ADHESION, ICE COVER STRENGTH, ICE JAMS, ICE FORECASTING, STRAIN MEASURING INSTRUMENTS
Frazil ice is a major cause of ice jams and other damaging ice accumulations in northern rivers. The ability to predict ice accumulation locations and rates of progression would aid in mitigating the adverse impacts associated with frazil ice accumulations. However, its accumulation processes are difficult to quantify because frazil ice is a highly variable material. Accumulation and progression rates depend on such factors as the size and concentration of individual particles, frazil floe size and surface concentration, and internal bonding mechanisms of frazil ice floes, all of which are affected by environmental conditions. Understanding the nature of the bonding mechanisms within frazil ice floes, and the conditions under which each type develops or becomes dominant, will allow us to predict the occurrence of such bonds and perhaps estimate the strength of the bonds. This will increase the ability to model the initiation and progression of frazil ice jams as well as to further define the conditions under which frazil ice accumulates. The bonding mechanisms of frazil ice were investigated through field tests of a prototype device. The test results revealed that frazil ice floes do exhibit some type of effective cohesion resulting in some degree of internal strength. The preliminary field tests suggested modifications to the measuring device which should allow us to obtain the data necessary for more detailed analysis of bond mechanisms in frazil ice floes.

MP 3570

ON THE SEDIMENT TRANSPORT CAPACITY OF RIVERS DURING ICE BREAKUP.

Ferrick, M.G., Weyrick, P.B., *Canada. National Hydrology Research Institute. Subcommittee on Hydraulics of Ice Covered Rivers. NHRI symposium, 1994, No.12, Workshop on Environmental Aspects of River Ice, Saskatoon, Saskatchewan, Aug. 18-20, 1993. Proceedings.* Edited by T.D. Prowse, p.161-175, 6 refs. 49-2369

RIVER ICE, ICE BREAKUP, ICE COVER EFFECT, ICE WATER INTERFACE, RIVER FLOW, SUSPENDED SEDIMENTS, SEDIMENT TRANSPORT, WATER EROSION, SOIL EROSION
Rivers transport large quantities of sediment during ice breakup. This transport causes physical, chemical and biological changes to occur in the water, or on the river floodplains, banks and bed. There are several breakup processes that initiate sediment motion or enhance transport. In this paper the authors quantify the bed load and suspended sediment transport capacities of an ice-covered river with the shear stress on the bed and a composite shear stress, respectively, obtained from a model that considers coupled flow and ice motion. The abrupt motion of a river ice cover decreases the resistance to the flow, causing surges to develop that significantly increase the shear stresses and the sediment transport capacities. A case study of breakup on the Connecticut River is generalized by varying model input parameters that may be uncertain, including the relative roughness of the ice and the bed, the ice velocity and acceleration through time, the flow velocity prior to ice motion, and the energy gradient of the flow. The results presented include the surging flow velocities, dimensionless ice/flow velocity ratios, and dimensionless shear stresses for the ice zone, bed zone and composite channel. In each case the authors quantify the relative increases in the shear stresses over time that are a direct result of the ice motion and parameter variation.

MP 3571

ANTIFREEZE ADMIXTURE FOR CONCRETE.

Cortez, E.R., Korhonen, C.J., *U.S. Patent Office. Patent, Mar. 22, 1994, n.p., USP-5,296,028.* 49-2466

CONCRETE FREEZING, CONCRETE ADMIXTURES, ANTIFREEZES, FROST PROTECTION, ICE PREVENTION

MP 3572

ALBE GEOGRAPHIC INFORMATION SYSTEM/ USER INTERFACE/GRAPHICS. VOLUME III. TECHNICAL DESIGN OVERVIEW (VERSION 2.0).

U.S. Army Waterways Experiment Station. Geotechnical Laboratory. Miscellaneous paper, Dec. 1992, GL-92-22, Var. p., The U.S. Army Cold Regions Research and Engineering Laboratory was one of the contributing organizations. 49-2494

ENVIRONMENT SIMULATION, COMPUTERIZED SIMULATION, COMPUTER PROGRAMS, MILITARY OPERA-

TION, TERRAIN IDENTIFICATION, WEATHER FORECASTING

MP 3573

ALBE GEOGRAPHIC INFORMATION SYSTEM/ USER INTERFACE/GRAPHICS. VOLUME I. PROGRAMMER'S GUIDE (VERSION 2.0).

U.S. Army Waterways Experiment Station. Geotechnical Laboratory. Miscellaneous paper, Dec. 1992, GL-92-41, Var. p., The U.S. Army Cold Regions Research and Engineering Laboratory was one of the contributing organizations. 49-2495

ENVIRONMENT SIMULATION, COMPUTERIZED SIMULATION, COMPUTER PROGRAMS, MILITARY OPERATION, TERRAIN IDENTIFICATION, WEATHER FORECASTING

MP 3574

ALBE GEOGRAPHIC INFORMATION SYSTEM/ USER INTERFACE/GRAPHICS. VOLUME II. LIBRARY REFERENCE (VERSION 2.0).

U.S. Army Waterways Experiment Station. Geotechnical Laboratory. Miscellaneous paper, Sep. 1992, GL-92-37, Var. p., The U.S. Army Cold Regions Research and Engineering Laboratory was one of the contributing organizations. 49-2496

ENVIRONMENT SIMULATION, COMPUTERIZED SIMULATION, COMPUTER PROGRAMS, MILITARY OPERATION, TERRAIN IDENTIFICATION, WEATHER FORECASTING

MP 3575

ALBE TACTICAL DECISION AID (TDA) USER'S GUIDE (VERSION 2.0). AIRLAND BATTLEFIELD ENVIRONMENT TECHNOLOGY DEMONSTRATION PROGRAM.

U.S. Army Waterways Experiment Station. Geotechnical Laboratory. Miscellaneous paper, Dec. 1992, GL-92-22, Var. p., The U.S. Army Cold Regions Research and Engineering Laboratory was one of the contributing organizations. 49-2497

ENVIRONMENT SIMULATION, COMPUTERIZED SIMULATION, COMPUTER PROGRAMS, MILITARY OPERATION, TERRAIN IDENTIFICATION, WEATHER FORECASTING

MP 3576

SNOWMELT RUNOFF AND TOTAL SOLIDS PRODUCTION IN A DISCONTINUOUS PERMAFROST BASIN.

Chacho, E.F., Jr., *Canada. National Hydrology Research Institute. NHRI symposium, 1992, No.10, International Northern Research Basins Symposium/ Workshop, 9th, Whitehorse, Yukon Territory, Aug. 14-22, 1992. Proceedings. Vol.1. Edited by T.D. Prowse, C.S.L. Ommannney, and K.E. Ulmer, p.59-76, 15 refs.* 49-2520

SNOW HYDROLOGY, SNOWMELT, DISCONTINUOUS PERMAFROST, PERMAFROST BENEATH RIVERS, PERMAFROST HYDROLOGY, RUNOFF, SUSPENDED SEDIMENTS, UNITED STATES—ALASKA—FAIRBANKS
Snowmelt runoff and total suspended solids were measured for two years on Glenn Creek, a small, second-order, subarctic stream located near Fairbanks, AK, within the Yukon-Tanana Uplands physiographic province. The stream drains a 2.25 km² research watershed of which 70% is underlain by permafrost. The two years of study represent very different snowmelt hydrographs due to differences in the snowpacks. In 1985, the snowpack was 180% of the long-term average, while in 1988 it was only 56% of the average. During both years, 60% of the total snowmelt-season water yield had passed before a significant rate of solids yield was observed. Also in both years the peak in total suspended solids concentration lagged the stream discharge peak by three days. Diurnal fluctuations in discharge and total suspended solids concentration are well-defined, including a peculiar occurrence of double diurnal peaks in the discharge hydrograph during portions of the snowmelt season. The diurnal fluctuations in solids concentration are shown to be consistent with water temperature fluctuations. In 1988, the percentage of organics in the total suspended solids was scattered from 0 to 50% during the snowmelt season.

MP 3577

RIVER ICE MOTION DURING DYNAMIC BREAKUP.

Ferrick, M.G., Weyrick, P.B., Nelson, D.F., *Canada. National Hydrology Research Institute. NHRI symposium, 1992, No.10, International Northern Research Basins Symposium/Workshop, 9th, Whitehorse,*

Yukon Territory, Aug. 14-22, 1992. Proceedings. Vol.1. Edited by T.D. Prowse, C.S.L. Ommannney, and K.E. Ulmer, p.101-121, 15 refs. 49-2522

RIVER ICE, ICE BREAKUP, ICE JAMS, ICE WATER INTERFACE, ICE COVER EFFECT, RIVER FLOW, MATHEMATICAL MODELS

The authors began a study of the dynamics of ice motion during river breakup by formulating a kinematic analysis. Ice continuity equations are applied to relate the speeds of a breaking front, a convergence front, a stoppage front, and a release front with the ice discharge and volume per unit surface area (unit volume) on either side of each front. Ice velocity data with time during a dynamic breakup were measured at a pair of sites bounding a short reach of the Connecticut River. An ice accumulation developed in this reach while the ice was in motion. The authors simulated the ice motion using the kinematic model and the data with the assumption of uniform accumulation thickness and porosity. Consistency between the model and the data required a specific accumulation length and unit ice volume, and this length was verified by independent measurement.

MP 3578

NRB WORKSHOP "ENVIRONMENTAL EFFECTS OF RIVER ICE": RAPPORTEUR REPORT.

Chacho, E.F., Jr., *Canada. National Hydrology Research Institute. NHRI symposium, 1992, No.10, International Northern Research Basins Symposium/ Workshop, 9th, Whitehorse, Yukon Territory, Aug. 14-22, 1992. Proceedings. Vol.2. Edited by T.D. Prowse, C.S.L. Ommannney, and K.E. Ulmer, p.701-704.* 49-2554

RIVER ICE, ICE COVER EFFECT, ENVIRONMENTAL IMPACT

MP 3579

LONG-TERM RECOVERY OF VEGETATION ON TWO EXPERIMENTAL CRUDE OIL SPILLS IN INTERIOR ALASKA BLACK SPRUCE TAIGA.

Racine, C.H., *Canadian journal of botany, Aug. 1994, 72(8), p.1171-1177, With French summary. 22 refs.* 49-2568

TAIGA, SUBARCTIC LANDSCAPES, OIL SPILLS, TREES (PLANTS), ECOSYSTEMS, SOIL POLLUTION, OIL RECOVERY, ENVIRONMENTAL IMPACT, ENVIRONMENTAL TESTS, REVEGETATION, PERMAFROST PRESERVATION, UNITED STATES—ALASKA—GLEN CREEK, UNITED STATES—ALASKA—CARIBOU-POKER CREEKS
Vegetation was sampled on two black spruce taiga sites in interior Alaska, 15 and 20 years after crude oil was experimentally applied as low-volume sprays or high-volume point spills. Low volume spray spills that uniformly covered the ground caused initial damage to vegetation, but after 20 years recovery of the understory vegetation was almost complete, with dramatic recovery and expansion of fruiting lichens. High-volume point spills created small areas of surface oil saturation with dead vegetation and little sign of recovery but spread out mostly belowground with little or no apparent effect on the shallowly rooted vegetation above even after 15-20 years. Because winter point spills created a much greater area of surface oil, their effects were more damaging. After 15 years on the saturated surface oiled areas, only *Eriophorum vaginatum* tussocks survive and grow. At both sites with surface oil, black spruce mortality was high, with no evidence of long-term recovery and with continuing chronic effects after 15 years. However, from a long-term perspective the black spruce taiga ecosystem appears to be able to recover from low volume spray spills and to retain large amounts of crude oil from high-volume point spills belowground with minimal damage to the vegetation. Because of the permafrost, removal of crude oil from this ecosystem by soil excavation is undesirable. *In situ* acceleration of oil breakdown using fertilizers and bacteria is a possible option; seeding or planting of *E. vaginatum* on surface-oiled areas may also provide some cover and belowground biomass.

MP 3580

METEOROLOGICAL ANALYSIS OF CHEMICAL EXCHANGE EVENTS IN THE ARCTIC BASIN.

Egan, W.G., Murphey, B.B., Hogan, A.W., *Science of the total environment, Jan. 1995, Vol.160/161, International Symposium on the Ecological Effects of Arctic Airborne Contaminants, Reykjavik, Iceland, Oct. 4-8, 1993. Collection of papers. Edited by D.H. Landers and S.J. Christie, p.87-99, 23 refs.* 49-2664

POLAR ATMOSPHERES, AIR POLLUTION, ATMOSPHERIC CIRCULATION, ATMOSPHERIC COMPOSITION, ATMOSPHERIC BOUNDARY LAYER, AIR WATER INTERACTIONS, SOIL AIR INTERFACE, AEROSOLS, OZONE

Analysis of chemical or aerosol exchange from the troposphere to the arctic surface is considerably more complex than similar analysis of arctic events. The complexity of chemical or aerosol exchange experiments in the Arctic requires considering occasional frontal exchange similar to that of the mid-latitudes, potential local contamination, and local sources of heat and moisture. These concerns are eliminated through site selection in most arctic exchange experiments. The inherent stability of near-surface layers in the arctic tropopause causes temporal anomalies when arrival times of aerosol or gaseous contaminants are compared with conservative meteorological tracers, further complicating the analysis. Three cases are presented. One illustrates the complexity in analyzing aerosol related to a warming event, the second describes the dimensions of a deep tropospheric mixing in the Arctic Basin, and the third examines the diurnal exchange of aerosol in the arctic summer. Some criteria relative to temporal resolution of aerosol and chemical measurements with respect to meteorological processes are proposed. Potential problems in distinguishing properties of aerosols transported from lower latitudes, in the presence of local aerosol sources, are discussed.

**MP 3581
PRELIMINARY EXPERIMENT TO EXAMINE
CHEMICAL EXCHANGE AT THE SOIL-SNOW
INTERFACE.**

Leggett, D.C., Hogan, A.W., *Science of the total environment*, Jan. 1995, Vol.160/161, International Symposium on the Ecological Effects of Arctic Airborne Contaminants, Reykjavik, Iceland, Oct. 4-8, 1993. Collection of papers. Edited by D.H. Landers and S.J. Christie, p.403-408, 16 refs.

49-2690
POLAR ATMOSPHERES, AIR POLLUTION, ATMOSPHERIC COMPOSITION, SOIL AIR INTERFACE, SOIL POLLUTION, SNOW AIR INTERFACE, SNOW IMPURITIES, SNOW PERMEABILITY, SNOW COVER EFFECT, SNOW COMPOSITION, VAPOR TRANSFER

Exchange of soil gases with the atmosphere is of current interest to researchers in several fields of geophysics and geochemistry. The authors have begun to examine the exchange of organic vapor at the soil-snow interface. The insights gained from this study may contribute to the general understanding of interfacial exchange processes. Soil specimens, spiked with organic solids having a great range of vapor pressure and aqueous solubility, were placed in shallow trays in contact with the surface prior to snowfall. Snow was allowed to accumulate over the trays and the temperature profiles within the adjacent snow and soil were recorded. Snow specimens were collected above the trays, with a height resolution of 1-5 cm, after exposure periods ranging from days to months. The snow specimens were analyzed with respect to density, particle size and chemical concentration. The preliminary results presented here indicate that organic materials with vapor pressure of the order of 10^{-3} to 10^{-6} torr achieved orderly concentration profiles coordinated with the distance from the source. Materials with greater or lesser vapor pressure were less orderly and refinement of the experimental method is necessary to understand this behavior. The experiment indicates that snow-pack provides temporary storage for organic contaminants, which may exchange with air or groundwater. More extensive experiments are necessary to define the processes regulating organic exchange in snow. The authors propose that analysis of overlying snow may provide a non-invasive method of surveying soil contamination.

**MP 3582
LAYER MODULI DETERMINATION DURING
FREEZE-THAW PERIODS.**

Janoo, V.C., Berg, R.L., *Transportation research record*, 1993, No.1377, Symposium on Nondestructive Deflection Testing and Backcalculation for Pavements, Nashville, TN, Aug. 19-21, 1991. Proceedings, p.26-35, 6 refs.

49-2745
PAVEMENTS, BITUMINOUS CONCRETES, BEARING STRENGTH, COLD WEATHER TESTS, FREEZE THAW TESTS, MECHANICAL PROPERTIES, THAW WEAKENING, STRUCTURAL ANALYSIS, STRAINS, DEFORMATION, COMPUTERIZED SIMULATION

In seasonal frost areas, a frozen pavement structure undergoes a complex change in its ability to support traffic as the subgrade and base thaw. In an attempt to quantify this change, several test sections of various cross sections were built in the Frost Effects Research Facility at the Cold Regions Research and Engineering Laboratory. These test sections were subjected to freeze-thaw cycles, and changes in their structural capacity were monitored. The performance of only one of these, TS1, is discussed. The structural capacity during the thaw cycles was characterized non-destructively using a falling weight deflectometer (FWD). Other measurements, such as frost and thaw depths, were obtained from subsurface temperature and resistivity gauges. The Corps of Engineers computer program WESDEF was used to backcalculate layer moduli from the FWD data. The basis of temperature and resistivity gauge measurements, the pavement layers were appropriately subdivided to reflect the thawed and frozen layers. The backcalculated moduli were used to calculate the horizontal strains at the bottom of the asphalt concrete layer and the vertical strain at the top of the subgrade. These results were compared

with those of similar strains obtained when the thawed and frozen layers were combined into a single composite layer. It was found that the thicknesses of the frozen and thawed layers were critical in backcalculating layer moduli and damage to pavement structures. Larger errors were introduced between measured and theoretical deflection basins when the frozen and thawed layers were considered as a single composite layer. The horizontal strains at the bottom of the asphalt layer were not greatly affected by ignoring the thawed layer. The damage to pavements with respect to vertical strains was grossly underestimated when the thawed and frozen layers were not considered separately.

**MP 3583
VARIATION IN AEROSOL CONCENTRATION
ASSOCIATED WITH A POLAR CLIMATE
ITERATION.**

Hogan, A.W., Riley, D., Murphey, B.B., Barnard, S.C., Samson, J.A., *American Geophysical Union. Antarctic Research Series*, 1993, Vol.61, Antarctic meteorology and climatology: studies based on automatic weather stations. Edited by D.H. Bromwich and C.R. Stearns, p.175-199, 119 refs.

49-2789
AEROSOLS, CLIMATE, AIR TEMPERATURE, ATMOSPHERIC DISTURBANCES, ANTARCTICA—ROSS ICE SHELF

This paper presents analyses which follow warm, aerosol-laden cyclonic systems across the Ross Ice Shelf, using automatic weather station data. Subsequent discussion indicates that marine aerosol deposits in the interior antarctic ice may reflect a recent climatic iteration of surface temperature and aerosol concentration. The antarctic continental (cA) air mass is rarely displaced from the south polar plateau, but it is frequently modified by exchange with antarctic maritime (mA) air advected from the ice shelves or frozen seas or with polar maritime (mP) air advected from the southern oceans. Because the cA air mass resides over an uninhabited and relatively static ice-covered surface, the concentration of aerosol particles in this unique air mass may reflect aerosol variation in the global atmosphere. Although a large seasonal variation in aerosol concentration is present, little year-to-year variation in mean seasonal aerosol concentration occurred prior to 1982. A consistent diminution of mean annual aerosol concentration occurred during the 1980s, and a concurrent reduction in sodium concentration in snow and firn was also found. (Auth. mod.)

**MP 3584
ANALYTICAL METHOD FOR WHITE PHOSPHORUS IN WATER.**

Walsh, M.E., *Bulletin of environmental contamination and toxicology*, 1995, 54(1), p.432-439, 21 refs.

49-2892
ENVIRONMENTAL TESTS, MILITARY RESEARCH, EXPLOSIVES, WATER POLLUTION, WATER CHEMISTRY, SAMPLING, LABORATORY TECHNIQUES, CHEMICAL ANALYSIS, STANDARDS

The objective of this work was to develop an analytical method capable of meeting water quality criteria for the protection of aquatic organisms that uses standard analytical instrumentation. The development focused on a preconcentration step suitable for a volatile, air-sensitive chemical. A nonevaporative preconcentration step is used that takes advantage of the favorable partitioning of white phosphorus (P_4) between organic and aqueous phases and the relatively high solubility of diethyl ether in water. P_4 is extracted from water using diethyl ether (10:1 water:solvent ratio). The ether phase is collected, then reduced in volume by shaking with reagent-grade water. By using the appropriate volume of water, excess ether is dissolved away, resulting in a preconcentration factor of 1000 while heat is avoided and loss of P_4 by volatilization minimized. P_4 is then determined by capillary gas chromatography and a nitrogen-phosphorus detector.

**MP 3585
VENTILATING ATTICS TO MINIMIZE ICINGS
AT EAVES.**

Tobiasson, W., Buska, J., Grotorex, A., *Home energy*, Mar./Apr. 1995, 12(2), p.35-38, For other versions see 48-3860 or 49-1609.

49-3085
COLD WEATHER CONSTRUCTION, BUILDINGS, ROOFS, ICICLES, ICE PREVENTION, VENTILATION

**MP 3586
ICE-STRUCTURE INTERACTION MODEL.**

Sodhi, D.S., *Mechanics of geomaterial interfaces*, Amsterdam, Elsevier Science B.V., 1995, p.57-75, 22 refs.

49-3086
ICE SOLID INTERFACE, ICE COVER STRENGTH, ICE LOADS, ICE DEFORMATION, ICE PRESSURE, ICE BREAKING, OFFSHORE STRUCTURES, MATHEMATICAL MODELS

A theoretical model to simulate ice-structure interaction during intermittent crushing is developed on the basis of experimental results from indentation tests, which were conducted by pushing vertical flat indentors into the edges of freshwater floating ice

sheets. An event during intermittent crushing comprises three phases: (1) a loading phase, (2) an extrusion phase and (3) a separation phase. The differential equations and solutions for each phase of interaction are presented along with conditions for termination of each phase. Besides simulating interaction during intermittent crushing, the model simulates the transition from intermittent to continuous crushing at high rates of indentation, as found during indentation tests. A few results from the model are presented to show the effect of various parameters on the velocity at which transition from intermittent to continuous crushing takes place and on the frequency of intermittent crushing.

**MP 3587
COMPARISON OF DEEP ICE CORES.**

Alley, R.B., Gow, A.J., Johnsen, S.J., Kipfstuhl, J., Meese, D.A., Thorsteinsson, T., *Nature*, Feb. 2, 1995, 373(6513), p.393-394, 6 refs.

49-3151
ICE CORES, ICE COMPOSITION, CLIMATIC CHANGES, GREENLAND

**MP 3588
SOME THOUGHTS ON SNOWLOADS.**

Tobiasson, W., *Structure*, Winter 1995, 2(1), p.14-15.

49-3171
SNOW LOADS, BUILDINGS, BUILDING CODES, DESIGN CRITERIA, ACCIDENTS

**MP 3589
APPLICATION OF DECISION TREES TO PREDICTING AVALANCHE ACTIVITY.**

Davis, R.E., Elder, K., *Avalanche review*, Feb. 1995, 13(4), p.3,7.

49-3216
AVALANCHE FORECASTING, SNOW COVER STABILITY, COMPUTERIZED SIMULATION

**MP 3590
COMPARISON OF COMMERCIAL COLORIMETRIC AND ENZYME IMMUNOASSAY FIELD SCREENING METHODS FOR TNT IN SOIL.**

Myers, K.F., McCormick, E.F., Strong, A.B., Thorne, P.G., Jenkins, T.F., *U.S. Army Corps of Engineers. Waterways Experiment Station. Installation Restoration Research Program. Technical report*, Dec. 1994, IRRP-94-4, 28p., 15 refs.

49-3220
SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, MILITARY FACILITIES, EXPLOSIVES

A study comparing two commercially available methods of field screening for TNT in soil used 99 soil samples from the Naval Surface Warfare Center, Crane, IN. All soil samples were analyzed using a commercial colorimetric method (EnSys) and a commercial enzyme immunoassay method (D TECH). The results were compared with those from the standard reversed-phase high performance liquid chromatography (RP-HPLC) laboratory method (SW846 Method 8330). The authors suggest that the D TECH kit is best suited to use in a pure field screening mode, where quantitative results are taken from laboratory analyses. Quantitative results from the EnSys kit appear to be of sufficient quality to permit rapid decisions in the field as to whether TNT concentrations are above or below an action concentration. When used according to manufacturer's directions, the D TECH kit produces results much more rapidly, since the EnSys kit requires that soils be dried prior to use.

**MP 3591
CORPS OF ENGINEERS TECHNOLOGY
TRANSFER.**

Link, L.E., Jr., *Army RD&A*, Mar.-Apr. 1995, p.10-13.

49-3380
RESEARCH PROJECTS, MILITARY RESEARCH, ORGANIZATIONS, LABORATORIES

**MP 3592
MECHANICAL FREEZING OF ALUM SLUDGE.**

Martel, C.J., *Water science & technology*, 1994, 30(8), p.177-184, 9 refs. For another source see 48-5376.

49-3399
WASTE TREATMENT, SEWAGE TREATMENT, SLUDGES, REFRIGERATION, FREEZING, MOISTURE TRANSFER, ICE WATER INTERFACE, MECHANICAL TESTS, DESIGN
This paper presents a new mechanical freezing concept for freezing alum or other hydroxide sludges as a conditioning step for dewatering. The basic concept is to freeze a thin layer of sludge on a continuously moving fabric belt. Sludge is attached to the belt by a vacuum drum belt filter which also removes one-half of the water and thus reduces the amount of sludge to be frozen. Filter leaf tests were conducted to determine the operational parameters and approximate production rates of this concept. The tests show that freezing alum sludge in thin layers will separate out the water as ice crystals and transform the solids into the same type of granular material produced in natural freezing beds. The average

production rate of frozen sludge was 6.5 kg/hr/m^2 at -20°C . The belt area needed for a $10,000 \text{ m}^3/\text{day}$ plant was estimated to be 48 m^2 . This concept has been patented by the U.S. Patent Office.

MP 3593

ROUND-ROBIN STUDY OF PERFORMANCE EVALUATION OF SOILS VAPOR-FORTIFIED WITH VOLATILE ORGANIC COMPOUNDS.

Hewitt, A.D., Grant, C.L., *Environmental science & technology*, Mar. 1995, 29(3), p.769-774, 22 refs. 49-3400

SOIL TESTS, ENVIRONMENTAL TESTS, SOIL POLLUTION, SOIL CHEMISTRY, STABILITY, SAMPLING, LABORATORY TECHNIQUES, VAPOR DIFFUSION, SOIL AIR INTERFACE, HYDROCARBONS, STANDARDS, CORRELATION, ACCURACY

Three soils were vapor-fortified with volatile organic compounds (VOCs) to produce materials suitable for performance evaluation and related quality assurance/control functions. Twelve laboratories analyzed two independently prepared sets of three different soil subsamples fortified with four VOCs. Analyte concentration estimates were reported for each soil subsample following a methanol extraction, purge-and-trap gas chromatography/mass spectrometry analysis (Method 8240, SW846). Relative standard deviations within individual soils ranged from 8.5 to 28.2%, with a pooled standard deviation of <13%. The best precision was for Ben (pooled RSD, 9.0%), while TDCE showed the greatest overall uncertainty (pooled RSD, 20.3%). These results confirm that vapor fortification, followed by confinement in sealed glass ampules, is a precise means of preparing and storing VOC-contaminated soil subsamples for use in quality assurance programs.

MP 3594

SPRAY CONTRIBUTION TO NET EVAPORATION FROM THE SEA: A REVIEW OF RECENT PROGRESS.

Andreas, E.L., Edson, J.B., Monahan, E.C., Rouault, M.P., Smith, S.D., *Boundary-layer meteorology*, 1995, 72(1), p.3-52, Refs. p.47-52. 49-3401

ATMOSPHERIC BOUNDARY LAYER, MARINE ATMOSPHERES, CLIMATOLOGY, SEA SPRAY, AIR WATER INTERACTIONS, EVAPORATION, DROPS (LIQUIDS), HEAT FLUX, MOISTURE TRANSFER, WIND FACTORS, MATHEMATICAL MODELS

This paper reviews recent work on how sea spray contributes to the sea surface heat and moisture budgets. In the presence of spray, the near-surface atmosphere is characterized by a droplet evaporation layer (DEL) with a height that scales with the significant-wave amplitude. The majority of spray transfer processes occur within this layer. As a result, the DEL is cooler and more moist than the atmospheric surface layer would be under identical conditions but without the spray. Also, because the spray in the DEL provides elevated sources and sinks for heat and moisture, the vertical heat fluxes are no longer constant with height. Eulerian and Lagrangian models and a simple analytical model are used to study the processes important in spray droplet dispersion and evaporation within this DEL. These models all point to the conclusion that, in high winds (above 15 m/s), sea spray begins to contribute significantly to the air-sea fluxes of heat and moisture. It is estimated that in a 20-m/s wind, with an air temperature of 20°C , a sea surface temperature of 22°C , and a relative humidity of 80%, the latent and sensible heat fluxes resulting from spray alone will have magnitudes of order 150 and 15 W/m^2 respectively in the DEL.

MP 3595

AIR-ICE DRAG COEFFICIENTS IN THE WESTERN WEDDELL SEA. 1. VALUES DEDUCED FROM PROFILE MEASUREMENTS.

Andreas, E.L., Claffey, K.J., *Journal of geophysical research*, Mar. 15, 1995, 100(C3), p.4821-4831, 40 refs. 49-3810

SEA ICE, ICE AIR INTERFACE, FRICTION, ATMOSPHERIC PRESSURE, SURFACE ROUGHNESS, TOPOGRAPHIC EFFECTS, WIND VELOCITY, PROFILES, VELOCITY MEASUREMENT, CORRELATION, SNOW COVER EFFECT, TURBULENT BOUNDARY LAYER, ANTARCTICA—WEDDELL SEA

From 197 hourly averaged, four-level wind-speed profiles collected on Ice Station Weddell (ISW) in Feb. and Mar. 1992, the authors compute the neutral stability, 10 m , air-drag coefficient, C_{D10} . Values range from 1.3×10^{-3} to 2.5×10^{-3} for the multi-year ice floe that was ISW. Individual C_{D10} values depend critically on how well the mean wind is aligned with the dominant snowdrift patterns. On ISW, 20% of the time there was drifting or blowing snow; when the wind speed at 5 m exceeded 8 m/s , such wind-driven snow was a virtual certainty. Consequently, the surface was continually changing, drifts were building and eroding. As the wind continued from a constant direction and the building drifts streamlined the surface, C_{D10} could decrease by as much as 30% in 12 hours. If the wind direction then shifted by as little as 20° , C_{D10} would immediately increase significantly. The implications are that snow-covered sea ice does not present an isotropic surface; it has a preferred direction dictated by the

wind's history. Consequently, computing surface stress using an average value for C_{D10} will produce errors of up to 30%. (Auth. mod.)

MP 3596

AIR-ICE DRAG COEFFICIENTS IN THE WESTERN WEDDELL SEA. 2. A MODEL BASED ON FORM DRAG AND DRIFTING SNOW.

Andreas, E.L., *Journal of geophysical research*, Mar. 15, 1995, 100(C3), p.4833-4843, 32 refs. 49-3811

SEA ICE, SURFACE ROUGHNESS, ICE AIR INTERFACE, TURBULENT BOUNDARY LAYER, PRESSURE RIDGES, FRICTION, SNOW COVER EFFECT, DRIFT, STRESS CONCENTRATION, WIND VELOCITY, TOPOGRAPHIC EFFECTS, MATHEMATICAL MODELS, ANTARCTICA—WEDDELL SEA

To investigate behavior of the neutral stability air-ice drag coefficient at a reference height of 10 m (C_{D10}), the author adapts a model developed by Raupach (1992) that partitions the total surface stress into contributions from form drag and skin friction. An essential part of this development was extending Raupach's model to the more complex geometry of sastrugi-like roughness elements. Assuming that 10 cm high sastrugi cover 15% of the surface, this physically based model reproduces the three main observations listed above. Thus the model seems to include the basic physics of air-ice momentum exchange. The main conclusion from this modeling is that 10 cm , sastrugi-like snowdrifts, rather than pressure ridges, sustain most of the form drag over compact sea ice in the western Weddell Sea. Secondly, the model suggests that skin friction accounts for about 60% of the surface stress when the wind is well aligned with the sastrugi; but when the wind is not well aligned, form drag accounts for about 80% of the stress. The sastrugi are thus quite effective in streamlining the surface. (Auth. mod.)

MP 3597

INDENTATION AND SPLITTING OF FRESH-WATER ICE FLOES.

Sodhi, D.S., Chin, S.N., *Journal of offshore mechanics and arctic engineering*, Feb. 1995, 117(1), p.63-69, 16 refs. For another version see 47-3751. 49-3818

ICE FLOES, ICE MECHANICS, MECHANICAL TESTS, ICE SOLID INTERFACE, ICE BREAKING, ICE STRENGTH, CRACKING (FRACTURING), IMPACT TESTS, CRACK PROPAGATION, ICE MICROSTRUCTURE, LOADS (FORCES)

Small-scale indentation and floc-splitting experiments were conducted on columnar ice floes of various sizes and at different speeds. During low-speed indentation, the ice floes always split apart, while at higher indentation speeds they did not. The reason is attributed to differences in the process of deformation and failure. At low speed, a large zone of microcracked ice forms in front of the indenter. Development of compressive stresses in the microcracked ice zone leads to buildup of transverse forces that drive crack propagation. These zones of microcracked ice are not observed during high-speed indentation. Rather, the ice fails by continuous crushing. The theoretical effective pressure required to split an ice floc, as predicted by Bhat (1988), agrees to some extent with those measured during experiments.

MP 3598

FOOTPRINT/ALTITUDE RATIO FOR HELICOPTER ELECTROMAGNETIC SOUNDING OF SEA-ICE THICKNESS: COMPARISON OF THEORETICAL AND FIELD ESTIMATES.

Kovacs, A., Holladay, J.S., Bergeron, C.J., Jr., *Geophysics*, Mar.-Apr. 1995, 60(2), p.374-380, 10 refs. 49-3897

SEA ICE, ICE COVER THICKNESS, GEOPHYSICAL SURVEYS, AERIAL SURVEYS, REMOTE SENSING, MAGNETOMETERS, SOUNDING, ELECTROMAGNETIC PROPERTIES, ACCURACY, ICE WATER INTERFACE, DESIGN

Helicopter-towed electromagnetic (HEM) induction sounding systems are typically used for geologic surveys. More recently, HEM systems have been used for the remote measurement of sea-ice thickness and shallow sea bathymetry. An important aspect of this remote sensing technology is the area, or footprint, in which the secondary field is predominantly generated by induced currents. A knowledge of the size of the footprint is important to understanding the accuracy of HEM sounding results over lateral variations in relief or conductivity. The view that the footprint diameter is a few times the HEM antenna altitude is confirmed using airborne measurements over sea ice to calculate the footprint size/antenna altitude ratio. These findings are compared to various theoretical estimates and are found to be in reasonable agreement. For a vertical coaxial coil antenna arrangement, the apparent footprint diameter was found to be about 1.3 times the antenna height above the sea-ice/water interface, and for a horizontal coplanar coil configuration the ratio is about 3.8 times the antenna height.

MP 3599

REMOTE SENSING AND GIS FOR EMERGENCY MANAGEMENT.

Bruzewicz, A.J., Federal Geographic Technology Conference, 1st, Washington, D.C., Sep. 26-28, 1994. GIS in government: the federal perspective, 1994, Fort Collins, CO, GIS World Books, 1995, p.161-164, 15 refs. 49-3934

REMOTE SENSING, SPACEBORNE PHOTOGRAPHY, DATA PROCESSING, REGIONAL PLANNING, ACCIDENTS, RESCUE OPERATIONS

MP 3600

NUMERICAL STUDIES OF THE RADIATION PATTERNS OF RESISTIVELY LOADED DIPOLES.

Arcone, S.A., *Journal of applied geophysics*, Jan. 1995, 33(1-3), p.39-52, 29 refs. 49-3964

GEOPHYSICAL SURVEYS, SUBSURFACE INVESTIGATIONS, PROFILES, GLACIER SURVEYS, RADIO ECHO SOUNDINGS, ANTENNAS, PERFORMANCE, ORIENTATION, DIELECTRIC PROPERTIES, WAVE PROPAGATION, ANALYSIS (MATHEMATICS)

The objective of these studies is to determine the two-way radar radiation patterns for finite resistivity loaded dipoles excited by a transient current pulse. Transient excitation of an infinitesimal dipole was first synthesized from the known steady-state solutions. Progressive transient excitations of each amplitude-weighted dipole element of an array were then superposed to yield the far-field response of a finite size antenna. Radiation response patterns are synthesized for several examples of media dielectric constants and antenna parameters based upon field applications in water, ice and permafrost ground. Comparisons between the numerical responses and field observations are presented.

MP 3601

QUASI-STEADY PROBLEMS IN FREEZING SOILS: IV. TRAVELING WAVE SOLUTIONS.

Nakano, Y., *Cold regions science and technology*, Nov. 1994, 23(1), p.1-17, 10 refs. 49-4103

SOIL FREEZING, FROZEN GRADE MECHANICS, FREEZING FRONT, FROST HEAVE, ICE GROWTH, MATHEMATICAL MODELS

In this work the steady growth of ice-rich frozen soil is studied. By deriving a traveling wave solution to the problem, it is found that the condition of steady growth of ice-rich frozen soil is uniquely determined by a set of two physical variables used earlier (Nakano, 1990) under given hydraulic conditions and overburden pressures. The traveling wave solution converges to the solution to the problem of a steadily growing ice layer when the velocity of the 0°C isotherm relative to the unfrozen part of the soil vanishes.

MP 3602

COMPARISON OF RADAR BACKSCATTER FROM ANTARCTIC AND ARCTIC SEA ICE.

Hosseinmostafa, A.R., Lytle, V.I., Jezek, K.C., Gogineni, S.P., Ackley, S.F., Moore, R.K., *Journal of electromagnetic waves and applications*, 1995, 9(3), p.421-438, 11 refs. 49-4159

ICE SURVEYS, SEA ICE DISTRIBUTION, ICE COVER THICKNESS, ICE DETECTION, ICE CONDITIONS, SNOW ICE INTERFACE, SLUSH, SNOW COVER EFFECT, RADIO ECHO SOUNDINGS, BACKSCATTERING, ANTARCTICA—WEDDELL SEA

Backscatter measurements were made at C band (5.3 GHz) over sea ice in the Weddell Sea from the German research vessel F.S. *Polarstern* during Sep. and Oct., 1989. Data were acquired on first-year (FY) and second-year (SY) snow-covered sea ice at stations where the ship stopped and detailed snow and ice characterizations were performed. Data were collected at incidence angles from 30° to 75° with all four linear polarizations. The results showed that the presence of slush at the snow-ice interface effectively masked the distinction between FY and SY ice in the Weddell Sea. Perhaps more importantly, it was found that it is possible to distinguish slush-covered and slush-free FY ice floes, depending on incidence angle. It was found that scattering from roughened slush-free ice was stronger than slush-covered ice at large incidence angles. At small incidence angles, quasi-specular reflection from slush-covered ice dominated the radar signal. The results further indicated that the volume scattering from the snow and from the ice was small at up to 50° angle of incidence. (Auth. mod.)

MP 3603

SHEAR-WAVE DETECTION OF ASYMMETRIC C-AXIS FABRICS IN THE GISP2 ICE CORE, GREENLAND.

Anandakrishnan, S., Fitzpatrick, J.J., Alley, R.B., Gow, A.J., Meese, D.A., *Journal of glaciology*, 1994,

40(136), p.491-496, 17 refs.
49-4184

ICE SHEETS, ICE MECHANICS, ULTRASONIC TESTS, ICE DEFORMATION, ICE CORES, ICE STRUCTURE, ORIENTATION, SHEAR STRESS, WAVE PROPAGATION, GREENLAND

The c-axis fabrics of the GISP2 ice core from central Greenland have been measured rapidly and accurately in the field, using both compressional and shear waves generated by an inexpensive, commercially available "idiot-proof" device. Compressional-wave data were collected at 10 m intervals for the upper 2250 m of the ice sheet, and show progressive clustering of c axes toward the vertical with increasing depth but no large steps at climatic boundaries in the core. The degree of clustering measured by ultrasound agrees closely with that measured using traditional optical techniques but the ultrasound technique is easier and faster than optical methods. A slight asymmetry in the c-axis clustering is revealed by the shear-wave data and increases with increasing depth, indicating that deformation is not symmetric about the vertical at the site.

MP 3604

LABORATORY MEASUREMENTS OF RADAR BACKSCATTER FROM BARE AND SNOW-COVERED SALINE ICE SHEETS.

Beaven, S.G., et al, *International journal of remote sensing*, Mar. 20, 1995, 16(5), p.851-876, 25 refs.
49-4236

SEA ICE, RADAR ECHOES, BACKSCATTERING, SNOW COVER EFFECT, POLARIZATION (WAVES), SNOW AIR INTERFACE, SURFACE ROUGHNESS, ICE OPTICS, DIELECTRIC PROPERTIES

Experiments were performed to collect radar backscatter data at K_u and C bands over simulated sea ice at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) during the 1990 and 1992 winter seasons. Experiments were conducted over bare saline ice grown in an indoor tank and an outdoor pond facility. The radar data were calibrated using a complex vector calibration scheme to reduce systematic effects. In conjunction with the radar measurements, ice physical properties were measured. These measurements demonstrate that the dominant backscatter mechanism for bare saline ice is surface scattering. Both the copolarized and cross-polarized measurements compare favorably with the predictions of surface scattering models at two frequencies.

MP 3605

OF WET SNOW, SLUSH AND SNOWBALLS.

Colbeck, S.C., *Avalanche review*, Mar. 1995, 13(5), p.4-5.
49-4280

WET SNOW, SLUSH, SNOW CRYSTAL STRUCTURE, SNOW CRYSTAL GROWTH, METAMORPHISM (SNOW), SNOW PERMEABILITY

MP 3606

CONSTRUCTION OF A GLACIAL ICE RUNWAY AND WHEELED FLIGHT OPERATIONS AT MCMURDO, ANTARCTICA.

Blaisdell, G.L., Lang, R., Crist, G., Kurtti, K., Harbin, J., Flora, D., Cambridge, England, Scientific Committee on Antarctic Research, [1994], 12p., 4 refs. Presented at the 6th SCALOP (Standing Committee on Antarctic Logistics and Operations) Symposium of the 23rd SCAR meeting, Aug. 29-31, 1994, Rome, Italy.
49-4283

ICE RUNWAYS, COLD WEATHER CONSTRUCTION, LOGISTICS, SITE SURVEYS, ICE (CONSTRUCTION MATERIAL), ICE STRENGTH, ANTARCTICA—MCMURDO STATION

Beginning in the 1989-90 summer season, engineering studies were directed at determining the feasibility of producing a runway for wheeled aircraft on the Ross Ice Shelf near McMurdo, specifically for use during the period after the sea ice deteriorates. Based on historical records and air photos, a site 13 km south of McMurdo was chosen in an area with a thin, but permanent and complete, snow cover. At this location, called the Pegasus site, the snow is underlain by a contiguous mass of glacial ice that is derived from a combination of natural seasonal melt water (near the surface) and ice formed by metamorphism of snow. A C-141 flight at the Pegasus runway in Feb. 1994 marked the final test in a five-year development program to demonstrate the feasibility of a semipermanent glacial ice runway capable of supporting heavy wheeled aircraft at a site easily accessible to McMurdo. In the later phases of developing the runway, numerous working flights took place using LC-130s operating on wheels and a conventional C-130. (Auth. mod.)

MP 3607

RESULTS FROM OPTICAL SCINTILLOMETERS OPERATED AT SEVILLETA, NEW MEXICO.

Otto, W.D., et al, *U.S. National Oceanic and Atmospheric Administration. Environmental Research Lab-*

oratories. Environmental Technology Laboratory. NOAA technical memorandum, Jan. 1995, ERL ETL-248, 29p., 7 refs.
49-4294

ATMOSPHERIC BOUNDARY LAYER, ATMOSPHERIC ATTENUATION, SOIL AIR INTERFACE, TURBULENCE, HEAT FLUX, LASERS, LIDAR, SCINTILLATION

The inner scale of turbulence l_0 and refractive structure parameter C_n^2 were obtained from measured atmospheric scintillation. Simultaneous propagation over two paths of different lengths was continuously monitored for 15 days; the two paths were nearly parallel. Two different diameters of the large aperture were used simultaneously on the long path. This results in three sets of l_0 and C_n^2 for intercomparison. The authors evaluate the use of inner-scale scintillometers on long (606 m) paths and the efficacy of correcting for strong scintillation. Design recommendations are given for a long-path inner-scale scintillometer. The authors also evaluate obtaining inner scale from the ratio of irradiance variances from HeNe and CO₂ lasers operated simultaneously over the same path.

MP 3608

COLLECTION, HANDLING, AND STORAGE:

KEYS TO IMPROVED DATA QUALITY FOR VOLATILE ORGANIC COMPOUNDS IN SOIL.

Hewitt, A.D., Jenkins, T.F., Grant, C.L., *American environmental laboratory*, Feb. 1995, 6p., 28 refs.
49-4331

SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, CHEMICAL ANALYSIS

MP 3609

HAT WAVELETS YIELD INCONCLUSIVE EVIDENCE OF RICHARDSON CASCADE.

Treviño, G., Andreas, E.L., Symposium on Boundary Layers and Turbulence, 11th, Charlotte, NV, Mar. 27-31, 1995. Preprint volume, Boston, American Meteorological Society, 1995, p.361-364, 7 refs.
49-4332

ATMOSPHERIC BOUNDARY LAYER, TURBULENT BOUNDARY LAYER, TURBULENCE, IMAGE PROCESSING, DATA PROCESSING, COMPUTERIZED SIMULATION, MATHEMATICAL MODELS

MP 3610

PANEL WALL HEATERS.

Haynes, F.D., *United States Committee on Large Dams. USCOLD newsletter*, July 1994, 1p.
49-4449

LOCKS (WATERWAYS), DAMS, ICE CONTROL, ICE PREVENTION, RADIANT HEATING

MP 3611

GENERATION OF ELECTRIC FIELDS BY ICE AND SNOW FRICTION.

Petrenko, V.F., Colbeck, S.C., *Journal of applied physics*, May 1, 1995, 77(9), p.4518-4521, 17 refs.
49-4510

ICE SOLID INTERFACE, ICE PHYSICS, SKIS, SLIDING, METAL ICE FRICTION, METAL SNOW FRICTION, CHARGE TRANSFER, ELECTRIC FIELDS, ICE ELECTRICAL PROPERTIES

Strong electric fields up to 2×10^6 V/m having potential up to 1.6 kV were generated in the gap between ice (or snow) and metallic and dielectric sliders, including alpine skis. Experimental data on the ice frictional electrification over wide ranges of sliding velocity and temperature are presented both for metal and dielectric sliders. Several possible physical mechanisms are discussed. The observed high magnitude of the potential difference V generated by friction between ice and sliders and the dependencies of V upon the slider velocity, ice conductivity, and temperature can be best explained in terms of high density electric charges picked up by a slider from the ice surface. The observed surface charge density corresponds to strong polarization of water molecules in the surface layer of ice. The phenomenon can play a significant role in forming a frictional force.

MP 3612

MAPPING C-AXIS FABRICS TO STUDY PHYSICAL PROCESSES IN ICE.

Alley, R.B., Gow, A.J., Meese, D.A., *Journal of glaciology*, 1995, 41(137), p.197-203, 27 refs.
49-4585

GLACIER ICE, SAMPLING, GRAIN SIZE, ICE CRYSTAL STRUCTURE, ORIENTATION, ICE DEFORMATION, ICE MECHANICS, THIN SECTIONS, ANTARCTICA—BYRD STATION

Mapping the spatial distribution of c-axis orientations in ice thin sections is not much more difficult than preparing c-axis scatter plots but can reveal additional information about processes responsible for the observed fabric and texture of the ice. Distributions of angles between c-axes of neighboring grains from the Byrd Station (West Antarctica) ice core suggest that polygonization causes average grain-size to stabilize below 400 m depth. (Auth.)

MP 3613

SHORT-PULSE RADAR WAVELET RECOVERY AND RESOLUTION OF DIELECTRIC CONTRASTS WITHIN ENGLACIAL AND BASAL AND ICE OF MATANUSKA GLACIER, ALASKA, U.S.A.

Arcone, S.A., Lawson, D.E., Delaney, A.J., *Journal of glaciology*, 1995, 41(137), p.68-86, 53 refs.
49-4573

GLACIER SURVEYS, ICE STRUCTURE, RADAR ECHOES, PROFILES, DIELECTRIC PROPERTIES, WAVE PROPAGATION, REFLECTIVITY, ICE WATER INTERFACE, UNITED STATES—ALASKA

Wavelets transmitted by short-pulse radar are recovered from continuous profiles and used to determine interfacial dielectric contrasts within the englacial and basal ice at the terminus area of Matanuska Glacier, Alaska. The field studies were in the ablation region, where radar horizons could at some point be identified with interfaces between clear ice and air, water or basal ice, and were performed in early spring before drainage fully developed. The profiles used closely spaced antennas with bandwidths centered near 50 and 400 MHz. Transmitted wavelets reflected from interfaces of known dielectric contrasts are used to establish a phase reference for other events from interfaces between unknown contrasts. Migration and Fourier-transform filtering are then applied to the profiles and shown to recover these wavelets from diffractions and reflections. Interfacial dielectric contrasts are determined from the relative phase of the wavelets.

MP 3614

POST-DRILLING RECRYSTALLIZATION OF THE BYRD STATION DEEP ICE CORE AND ITS RELEVANCE TO CURRENT AND FUTURE DEEP-CORE DRILLING ON POLAR ICE SHEETS.

Gow, A.J., *Annals of glaciology*, 1994, Vol.20, International Symposium on Antarctic Glaciology, 5th, Cambridge, England, Sep. 5-11, 1993. Proceedings, p.231-236, 4 refs.
49-4945

ICE SHEETS, ICE CORES, RECRYSTALLIZATION, ICE MICROSTRUCTURE, ICE CRYSTAL STRUCTURE, ICE CRYSTAL SIZE, ICE DEFORMATION, ANTARCTICA—BYRD STATION

Cores of highly strained ice recovered from depths of 1200-1800 m at Byrd Station in 1967-68 have been found to have recrystallized while in storage in the United States. Such recrystallization, inferred to have occurred when temperatures in the storage facility rose above about -14°C, would not have been discovered if thin sections of the cores had not been prepared and photographed at the drill site within hours of pulling the cores to the surface. It was only after new sections of the long-stored cores were compared with the original sections that the full extent of recrystallization was revealed. The recrystallized structure emulates in both texture and fabric those observed in naturally annealed ice in the bottom 350 m at Byrd Station. It is concluded that polar ice cores should be stored at temperatures of -20°C or colder in order to inhibit or minimize post-drilling recrystallization. (Auth.)

MP 3615

80 YEAR RECORD OF RETREAT OF THE KOETTLITZ ICE TONGUE, MCMURDO SOUND, ANTARCTICA.

Gow, A.J., Govoni, J.W., *Annals of glaciology*, 1994, Vol.20, International Symposium on Antarctic Glaciology, 5th, Cambridge, England, Sep. 5-11, 1993. Proceedings, p.237-241, 12 refs.
49-4946

GLACIER SURVEYS, GLACIER TONGUES, GLACIER OSCILLATION, GLACIER ABLATION, CALVING, ICE EDGE, ANTARCTICA—KOETTLITZ GLACIER

A survey of ice-front changes since 1910-13 shows that the Koettlitz Ice Tongue, located along the western shore of McMurdo Sound, has undergone significant retreat during the past 80 years. The ice front in 1910-13 was located 5 km in front of the Dailey Is. Today, only two of the six Dailey Is. remain connected to the Koettlitz Ice Tongue. The most recent break-out of ice is believed to have occurred in 1979 or 1980, resulting in an estimated loss of 80 km² of ice. Based on the current position of the ice front, it is estimated that a minimum of 300 km² of ice has calved off the Koettlitz Ice Tongue during the 80 year period that has elapsed since the ice front was first mapped in 1910-13. (Auth.)

MP 3616

EFFECT OF AEROSOLS ON PH OF SNOW-FALLS.

Kumai, M., *Annalen der Meteorologie*, 1988, No.25, International Cloud Physics Conference, 10th, Bad Homburg, Germany, Aug. 15-20, 1988. Preprints. Vol.1, p.249-250, 1 ref.
49-5013

AEROSOLS, ATMOSPHERIC COMPOSITION, SNOW AIR INTERFACE, SNOWFALL, SNOW COMPOSITION, SNOW IMPURITIES, SCAVENGING

MP 3617

LABORATORY AND FIELD ANALYTICAL METHODS FOR EXPLOSIVES RESIDUES IN SOIL.

Walsh, M.E., Jenkins, T.F., Thorne, P.G., Symposium on Alternatives to Incineration for Disposal of Chemical Munitions and Energetics. Proceedings, Vol.2. Energetics, Hoboken, Stevens Institute of Technology, June 1995, 29p., 90 refs.

49-5165

EXPLOSIVES, SEDIMENTS, SOIL CHEMISTRY, SOIL POLLUTION, SOIL TESTS, CHEMICAL ANALYSIS, LABORATORY TECHNIQUES, SAMPLING, ENVIRONMENTAL TESTS, WASTE DISPOSAL

Standard analytical methods have been developed to characterize explosives residues in soil at U.S. Department of Defense installations. The laboratory analysis is conducted using reversed phase high performance liquid chromatography (RP-HPLC) and the most commonly found analytes are TNT and RDX. Other analytes commonly detected are the environmental transformation products of TNT including TNB, dinitroaniline, and the isomers of amino-DNT, and the manufacturing by-products DNB and the isomers of DNT. Field methods designed to detect TNT and RDX have enhanced site characterization by providing rapid on-site results for a greater number of samples than would be economically feasible by depending solely on off-site laboratory analyses for all samples. Attempts may be made to use both laboratory and field methods to analyze treatment matrices, such as incinerator ash and compost, but further analytical method development is needed to enhance extraction and minimize interferences.

MP 3618

IDENTIFICATION AND CLASSIFICATION OF FROST SUSCEPTIBLE SOILS.

Chamberlain, E.J., Gaskin, P.N., Esch, D., Berg, R.L., ASCE Spring Convention, Las Vegas, NV, Apr. 26-30, 1982. Preprint, New York, American Society of Chemical Engineers, 1982, 38p., 36 refs.

49-5212

SOIL CLASSIFICATION, SOIL TESTS, SOIL FREEZING, MECHANICAL PROPERTIES, FROST ACTION, COLD WEATHER CONSTRUCTION, SPECIFICATIONS, STANDARDS

Methods for determining the frost susceptibility of soil and granular materials used in road and airfield construction are reviewed. The methods employed by transportation departments in the United States, Canada and Europe are included. Three levels of classification are identified; Type I, based on a specified particle size; Type II, generally based on soil type; and Type III, which requires a laboratory freezing test. Two critical particle sizes appear frequently, 0.074 and 0.020 mm. The most common basis is the Casagrande criteria; however, few transportation agencies use the same method, as modifications have been made to address specific problems. The reliability of most criteria is uncertain because few have been rigorously validated. Transportation agencies should have all three types available, and possibly a fourth and even more discriminating method, to select criteria appropriate to the task.

MP 3619

OVERVIEW OF EXPLOSIVES CONTAMINATION AT DOD FACILITIES: AN ANALYTICAL PERSPECTIVE.

Jenkins, T.F., Walsh, M.E., Annual Meeting of Air & Waste Management Association, 88th, San Antonio, TX, June 18-23, 1995, Air & Waste Management Association, 1995, 18p., 98 refs.

49-5232

MILITARY FACILITIES, EXPLOSIVES, WASTE DISPOSAL, SOIL POLLUTION, SOIL ANALYSIS, ENVIRONMENTAL IMPACT, ENVIRONMENTAL TESTS, CHEMICAL ANALYSIS, LABORATORY TECHNIQUES

The purpose of this paper is to provide an overview of the explosives contamination problem at DoD facilities from an analytical chemistry perspective, with emphasis on the compounds found in explosives-contaminated soils and laboratory and field methods that have been used for site characterization.

MP 3620

COMMENTS ON "CRITICAL EVALUATION OF PREDICTED AND MEASURED GAS-LIQUID PARTITION COEFFICIENTS IN N-HEXADECANE".

Leggett, D.C., *Journal of physical chemistry*, June 8, 1995, p.9638, 1 ref.

49-5233

GASES, HYDROCARBONS, FUELS, THERMODYNAMICS, CHEMICAL ANALYSIS, PHASE TRANSFORMATIONS, SOLUBILITY

MP 3621

SEASONAL SNOW COVER CLASSIFICATION SYSTEM FOR LOCAL TO GLOBAL APPLICATIONS.

Sturm, M., Holmgren, J., Liston, G.E., *Journal of climate*, May 1995, 8(5)pt.2, p.1261-1283, 72 refs.

49-5255

SNOW COVER DISTRIBUTION, SNOW COVER STRUCTURE, SNOW SURVEYS, CLASSIFICATIONS, TERMINOLOGY, MAPPING, CORRELATION, CLIMATIC FACTORS, METEOROLOGICAL FACTORS, STRATIGRAPHY

A new classification system for seasonal snow covers is proposed. It has six classes (tundra, taiga, alpine, maritime, prairie, and ephemeral), each class defined by a unique ensemble of textural and stratigraphic characteristics within each layer. The classes can also be derived using a binary system of three climate variables: wind, precipitation, and air temperature. Using this classification system, the Northern Hemisphere distribution of the snow cover classes is mapped on a 0.5° lat x 0.5° long grid. These maps are compared to maps prepared from snow cover data collected in the former Soviet Union and Alaska. Factor analysis indicates that the snow classes can be readily discriminated using four or more winter average thermal or physical parameters. Further, analysis of hourly time series indicates that 84% of the time, spot measurements of the parameters are sufficient to correctly differentiate the snow cover class.

MP 3622

TEMPERATURE OF EVAPORATING SEA SPRAY DROPLETS.

Andreas, E.L., *Journal of the atmospheric sciences*, Apr. 1, 1995, 52(7), p.852-862, 22 refs.

49-5389

MARINE METEOROLOGY, ATMOSPHERIC PHYSICS, TURBULENT BOUNDARY LAYER, TURBULENT DIFFUSION, SEA SPRAY, DROPS (LIQUIDS), EVAPORATION, TEMPERATURE MEASUREMENT, FORECASTING, MATHEMATICAL MODELS, HEAT TRANSFER

This paper uses a full microphysical model to accurately predict the evaporating temperature, T_{ev} , of pure and saline droplets to investigate how close wet-bulb thermometer temperature (T_{wet}) is to this temperature. In general, T_{wet} is within $0.2-0.3^\circ\text{C}$ of T_{ev} for droplets with salinities from 0 to 40 psu when the droplet radius is $10\text{ }\mu\text{m}$ or greater. When the droplet radius is less than $10\text{ }\mu\text{m}$, however, T_{wet} can underestimate T_{ev} badly, especially for higher air temperatures. To provide accurate estimates of T_{ev} quickly, the paper describes an algorithm that predicts T_{ev} to within 0.3°C of the temperature predicted by the full model for droplets with radii from 0.5 to $500\text{ }\mu\text{m}$ when air temperatures are from -10 to 30°C , relative humidities are from 80 to 97.5% and droplet salinities are from 0 to 40 psu.

MP 3623

LOW-LEVEL ATMOSPHERIC JETS AND INVERSIONS ON ICE STATION WEDDELL 1.

Andreas, E.L., Claffey, K.J., Makshtas, A.P., *Antarctic journal of the United States*, 1993, 28(5), p.274-276, 9 refs.

49-5596

METEOROLOGICAL DATA, WEATHER OBSERVATIONS, METEOROLOGICAL INSTRUMENTS, WIND (METEOROLOGY), ANTARCTICA—WEDDELL SEA

During deployment on Ice Station Weddell 1 (ISW-1) in 1992 the authors launched radiosondes, typically at 00 and 12 Greenwich mean time (GMT) to investigate the structure of the lower atmosphere. Near the end of the drift in late May and early June, they launched simultaneous radiosondes from ISW-1 and from the *Akademik Fedorov* at 00, 06, 12, and 18 GMT as the *Fedorov* approached from the northeast to help disassemble the station. Here the authors report some preliminary results from this radiosounding program.

MP 3624

MANIPULATING THE TEMPERATURE OF AN ARCTIC TUNDRA PLOT: CONSIDERATIONS FOR THE ITEX STUDY.

Albert, M.R., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, [1991], 12p. + figs., Unpublished manuscript. 6 refs.

49-5435

TUNDRA, PLANT ECOLOGY, VEGETATION PATTERNS, REVEGETATION, SNOW COVER EFFECT, PERMAFROST HEAT TRANSFER, RADIATION BALANCE, GLOBAL WARMING, ENVIRONMENTAL TESTS

One of the goals of the planned International Tundra experiment is to study the effects of an in-situ warming on the flora of selected tundra sites. Initial ideas delineated at the ITEX workshop included the use of subsurface heating equipment, artificial lighting, greenhouses, and open-topped chambers. The purpose of this paper is to put forth the idea of local heating in a simple, inexpensive, and minimally intrusive manner, by capitalizing on the radiation absorption characteristics of various ground covers. Several simple numerical experiments are performed to demonstrate that the nature of the ground surface cover can have a profound effect on the local thermal regime. General guidance is given for the placement of introduced ground covers.

MP 3625

STATISTICS OF SURFACE-LAYER TURBULENCE AND EVALUATIONS OF EDDY-ACCUMULATION COEFFICIENTS.

Andreas, E.L., Symposium on Boundary Layers and Turbulence, 11th, Charlotte, NC, Mar. 27-31, 1995. Preprint volume, Boston, American Meteorological Association, 1995, p.106-109, 16 refs.

49-5452

ATMOSPHERIC BOUNDARY LAYER, TURBULENT BOUNDARY LAYER, TURBULENT DIFFUSION, WIND VELOCITY, STATISTICAL ANALYSIS, FLUID DYNAMICS

MP 3626

WEDGING ACTION DURING VERTICAL PENETRATION OF FLOATING ICE SHEETS.

Sodhi, D.S., Ice mechanics. Edited by J.P. Dempsey and Y.D.S. Rajapakse, American Society of Mechanical Engineers, 1995, AMD-Vol.207, 24 refs.

49-5453

FLOATING ICE, ICE SHEETS, ICE MECHANICS, LOADS (FORCES), ICE DEFORMATION, CRACK PROPAGATION, PENETRATION TESTS, ICE SOLID INTERFACE, MECHANICAL TESTS, STRESS CONCENTRATION, ULTIMATE STRENGTH

Small-scale experiments were conducted with freshwater ice in a basin to understand wedging action during the vertical loading of floating ice sheets. Results of the following series of experiments are presented: (a) beams with fixed ends, (b) paired cantilever beams arranged free-end to free-end and loaded together, (c) beams with an apparatus inserted between the free ends of paired cantilever beams to measure the in-plane force during vertical loading, and (d) vertical downward loading of floating ice sheets with fixed and free boundaries. Analysis of the data from the beam tests reveals that the wedging action results in the development of wedging pressure in the top or bottom third of the ice thickness, and that this results in a resisting moment that counters the deformation of a cracked ice sheet. An ice sheet attached to the basin walls inhibits the propagation of radial cracks because of the wedging action, whereas an ice sheet free at the edges from the surrounding ice sheet fails by the propagation of radial cracks all the way to the ice sheet's free boundary. The difference between the two breakthrough loads of the free and the fixed ice sheets can be attributed to wedging action. The results of the beam tests are used to predict the breakthrough loads of floating ice sheets, which are in agreement with loads measured during full-scale and small-scale experiments.

MP 3627

TRIAXIAL TESTS ON DRY, NATURALLY OCCURRING SNOW.

Lang, R.M., Harrison, W.L., *Cold regions science and technology*, Feb. 1995, 23(2), p.191-199, 14 refs.

49-5488

SNOW MECHANICS, MECHANICAL TESTS, STRAIN TESTS, ICE SOLID INTERFACE, LOADS (FORCES), SNOW PLASTICITY, PLASTIC DEFORMATION, ULTIMATE STRENGTH

This study presents and discusses the results of triaxial tests conducted on dry, naturally occurring snow. The applied strain rate for the fresh snow was $1.01 \times 10^{-3}/\text{s}$ and the confining pressure was varied from 0 to 41.37 kPa. Stress-deformation curves are presented and snow behavior is represented within the context of a critical state model (Roscoe et al., 1963). Under these specific loading conditions the stress-deformation curves demonstrate that snow exhibits an instantaneous response which can be characterized for computational purposes as an isotropic, nonlinear, elastic-plastic strain hardening material. The loading conditions did not promote viscous behavior of the snow and viscous effects are not considered. When the results are corrected to true stress, the snow continues to deform without an increase in load beyond the limit load. Also, the effect of increased ultimate strength with increased confining pressure was, in general, apparent for snow.

MP 3628

LOW-TEMPERATURE HIGH STRAIN RATE BEHAVIOR OF GR/EP LAMINATE UNDER TRANSVERSE IMPACT.

Dutta, P.K., Hui, D., Advanced structural fiber composites. Edited by P. Vincenzini, Techna, 1995, p.455-468, 19 refs.

49-5647

COMPOSITE MATERIALS, STRAIN TESTS, IMPACT TESTS, DYNAMIC LOADS, STRESS CONCENTRATION, LOW TEMPERATURE TESTS, TEMPERATURE EFFECTS,

ELASTIC PROPERTIES

The influence of high strain rate and low temperatures on the transverse (through-the-thickness) behavior of a graphite/epoxy composite system was studied using the CRREL split Hopkinson pressure bar apparatus. The compressive data generated include strength to failure, strain to failure, pre- and post-failure stress-strain behavior, and the strain energy to failure. The test temperature ranged from 24°C to -60°C and strain rate from 100 to 300 strains per second. The study provides relationships between the transverse elastic modulus and the strain rates at different temperatures. Data obtained from such tests would be useful in prediction of the transverse impact behavior, especially the failure mechanisms, for a wide range of low-temperature conditions.

MP 3629

CYCLIC LOADING OF SALINE ICE.

Cole, D.M., Durell, G.D., *Philosophical magazine A*, July 1995, 72(1), p.209-229, 49 refs.

49-5661

ICE MECHANICS, SALT ICE, MECHANICAL TESTS, STRESS CONCENTRATION, STRAIN TESTS, DYNAMIC LOADS, MECHANICAL PROPERTIES, ICE MICROSTRUCTURE, ICE RELAXATION, TEMPERATURE EFFECTS

This paper details the results of an experimental program to investigate the constitutive behavior of saline ice under reversed direct-stress conditions. The test material was laboratory-grown saline (NaCl) ice. The work explored the effects of temperature (from -5 to -50°C), cyclic stress amplitude (0.1-0.8 MPa) and loading frequency (10^{-2} -1 Hz) on the response of the ice. Variations in the ice growth conditions allowed the effects of microstructural variations to be investigated as well, with total porosity in the range 30-104 ppt. The experiments were generally performed by applying a sinusoidally varying uniaxial load, oscillating about zero, to the cylindrical specimens. Several experiments employed cyclic strain control. The material response was typically composed of elastic and anelastic strain, with various degrees of permanent or viscous strain occurring at higher temperatures and lower frequencies, and proved to be very sensitive to variations in loading conditions and to microstructural variations. An increase in total porosity caused a decrease in the effective modulus and an increase in the anelastic strain. The ice exhibited a very complex temperature dependence, a stress dependence that was approximately linear at low temperatures but nonlinear at high temperatures, and a significant frequency effect.

MP 3630

NORTHERN SEA ROUTE RECONNAISSANCE REPORT: HISTORY AND PRESENT STATUS OF OPERATIONS.

Mulherin, N.D., Northern Sea Route reconnaissance report, Vol.1, Appendix A, Anchorage, AK, U.S. Army Corps of Engineers, Alaska District., June 1995, 85p., Refs. p.68-71.

49-5676

HISTORY, MARINE TRANSPORTATION, ICE NAVIGATION, PORTS, SHIPS, COST ANALYSIS, LEGISLATION, INTERNATIONAL COOPERATION, ICE CONDITIONS, SEA ICE, ICEBREAKERS, NORTHERN SEA ROUTE

MP 3631

NORTHERN SEA ROUTE RECONNAISSANCE REPORT: TRANSIT MODEL DEVELOPMENT AND RESULTS. DRAFT.

Mulherin, N.D., Eppler, D.T., Farmer, L.D., Proshutinskaia, T.O., Proshutinski, A.I.U., Smith, O.P., Northern Sea Route reconnaissance report, Vol.3, Appendix G, Anchorage, AK, U.S. Army Corps of Engineers, Alaska District., June 1995, 289p., Refs. p.45-46.

49-5682

MARINE TRANSPORTATION, COST ANALYSIS, MODELS, NAVIGATION, SIMULATION, ICE NAVIGATION, ICE COVER THICKNESS, NORTHERN SEA ROUTE, RUSSIA

MP 3632

NORTHERN SEA ROUTE RECONNAISSANCE REPORT: A SUMMARY OF ICEBREAKING TECHNOLOGY.

Sodhi, D.S., Northern Sea Route reconnaissance report, Vol.2, Appendix C, Anchorage, AK, U.S. Army Corps of Engineers, Alaska District., June 1995, 233p., Refs. p.47-49.

49-5678

ICEBREAKERS, SHIPS, DESIGN, DESIGN CRITERIA, PROPELLERS, ICE NAVIGATION, PORTS, NORTHERN SEA ROUTE, RUSSIA

MP 3633

OBSERVATIONS OF ULTRAVIOLET LIGHT REFLECTION AND TRANSMISSION BY FIRST-YEAR SEA ICE.

Perovich, D.K., *Geophysical research letters*, June 1, 1995, 22(11), p.1349-1352, 19 refs.

49-5812

SEA ICE, YOUNG ICE, ELECTROMAGNETIC PROPERTIES, ULTRAVIOLET RADIATION, TRANSMISSIVITY, ICE OPTICS, RADIATION ABSORPTION, ALBEDO, SNOW COVER EFFECT, ATTENUATION

As part of a comprehensive program investigating the electromagnetic properties of sea ice, measurements were made of the optical properties of young ice and first-year sea ice at ultraviolet wavelengths. Young sea ice observations were made in a specially designed sea ice pond at the Cold Regions Research and Engineering Laboratory, while first-year sea ice was examined in the Chukchi Sea and Beaufort Sea near Barrow, AK. The results indicated that, in general, albedo increased with increasing wavelength from 305 to 380 nm, with values for first-year ice in the 0.4 to 0.6 range. Transmittance through bare first-year ice was roughly 0.5 to 2%. Extinction coefficients for bare sea ice were between 2 and 4/m and decreased with increasing wavelength. The presence of a snow cover had a profound impact on ultraviolet light levels under sea ice, with even a thin (0.1-m thick) snow cover reducing transmitted ultraviolet light by more than an order of magnitude. Observed transmittances indicated that the attenuation of ultraviolet light by sea ice and snow was greater than that of the photosynthetically active radiation.

MP 3634

TOWED SNOW PLOW FOR THE SMALL UNIT SUPPORT VEHICLE (SUSV).

Walsh, M.R., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1995, SR 95-9, International Conference on Cold Weather Military Operations, Burlington, VT, Feb. 28-Mar. 2, 1995. Proceedings. Edited by N.H. Collins, p.135-144, 4 refs.

49-5778

MILITARY EQUIPMENT, COLD WEATHER OPERATION, TRACKED VEHICLES, SNOW REMOVAL, COLD WEATHER TESTS, PERFORMANCE, DESIGN

MP 3635

BASIC RESEARCH AND COLD WEATHER OPERATIONS.

Ashton, G.D., Harmon, R.S., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1995, SR 95-9, International Conference on Cold Weather Military Operations, Burlington, VT, Feb. 28-Mar. 2, 1995. Proceedings. Edited by N.H. Collins, p.155-161.

49-5780

MILITARY OPERATION, MATERIALS, COLD WEATHER OPERATION, RESEARCH PROJECTS, COLD WEATHER TESTS, DESIGN

MP 3636

ENHANCED MOBILITY FOR COLD REGIONS.

Shoop, S.A., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1995, SR 95-9, International Conference on Cold Weather Military Operations, Burlington, VT, Feb. 28-Mar. 2, 1995. Proceedings. Edited by N.H. Collins, p.179-186, 17 refs.

49-5782

VEHICLES, COLD WEATHER PERFORMANCE, SNOW COVER EFFECT, TRACTION, ICE SOLID INTERFACE, TEMPERATURE EFFECTS, RESEARCH PROJECTS

MP 3637

SNOW DRIFTING PROBLEMS AND ABATEMENT.

Lever, J., Haehnel, R., Wilkinson, J., *U.S. Army Cold Regions Research and Engineering Laboratory. Special report*, 1995, SR 95-9, International Conference on Cold Weather Military Operations, Burlington, VT, Feb. 28-Mar. 2, 1995. Proceedings. Edited by N.H. Collins, p.301-305.

49-5786

SNOWDRIFTS, COUNTERMEASURES, SNOW PHYSICS, BLOWING SNOW, SNOW AIR INTERFACE, WIND FACTORS, WIND TUNNELS, SIMULATION

MP 3638

IN-SITU DIELECTRIC CONSTANT OF POLAR FIRN REVISITED.

Kovacs, A., Gow, A.J., Morey, R.M., *Cold regions science and technology*, May 1995, 23(3), p.245-256, 45 refs.

49-6042

ICE SHEETS, FIRN, REMOTE SENSING, RADIO ECHO SOUNDINGS, ICE DIELECTRICS, ICE PHYSICS, DIELECTRIC PROPERTIES, ICE CORES, CORRELATION, ANALYSIS (MATHEMATICS), ANTARCTICA—MCMURDO ICE SHELF

The success in using VHF and UHF systems for sounding polar

ice sheets has been tempered by an uncertainty in the *in-situ* dielectric constant which controls the effective velocity of an electromagnetic wave propagating in an air-ice mixture. An empirical equation for determining the relative real dielectric constant vs. density of firn or ice was proposed in 1969 by Robin et al. where dielectric constant = $(1+0.851\rho)^2$. However, this expression has met with uncertainty because wide-angle radar refraction sounding techniques have produced dielectric constant values that are lower than Robin's equation predicts. This paper discusses radar soundings made on the McMurdo Ice Shelf and compares the resulting dielectric constant determinations with Robin's equation, laboratory measurements on firn and ice and other expressions given in the literature for determining the dielectric constant vs. the specific gravity of dry firn and ice. These findings indicate that the form of Robin's equation is valid. Reasons are suggested as to why previous wide-angle radar sounding studies did not reproduce Robin's findings. (Auth. mod.)

MP 3639

RADAR BACKSCATTER MEASUREMENTS FROM SIMULATED SEA ICE: CRRELEX'93 RESULTS.

Kanagaratnam, P., Gogineni, S.P., Beaven, S.G., Jezek, K.C., Zabel, I., *Kansas University. Radar Systems and Remote Sensing Laboratory. Technical report*, June 1994, RSL-TR-8243-3, n.p., ADA-281 159, 5 refs.

49-5984

ICE SURVEYS, SEA ICE, ICE DETECTION, ICE SURFACE, ICE COVER THICKNESS, SNOW ICE INTERFACE, RADAR ECHOES, BACKSCATTERING, ENVIRONMENTAL TESTS

The authors performed radar backscatter measurements on artificially grown sea ice in an indoor facility at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) during the 1993 winter season. The objectives of these experiments were to study various mechanisms for simulating roughness and to better understand backscatter mechanisms. Backscatter measurements were made at 13.9 GHz and for incident angles ranging from 0 to 55° with all four linear polarization combinations: VV, HH, VH, and HV. In addition to the backscatter measurements from saline ice, the return from three calibration targets were measured. These targets included a Luneburg lens, a metal sphere and a dihedral corner reflector. These measurements eliminated the systematic error due to polarization impurity of the antenna and other systems effects.

MP 3640

VEHICLE BEARING CAPACITY OF FROZEN GROUND OVER A SOFT SUBSTRATE.

Shoop, S.A., *Canadian geotechnical journal*, June 1995, 32(3), p.552-556, With French summary. 16 refs.

49-6059

FROZEN GROUND STRENGTH, FROZEN GROUND COMPRESSION, BEARING STRENGTH, SUBSTRATES, MOTOR VEHICLES, TRAFFICABILITY, FROST PENETRATION, STANDARDS

Freezing temperatures may allow the use of vehicles and heavy equipment on otherwise inaccessible or sensitive areas such as swamps, bogs, tundra, and peatlands. Predicting operable conditions in frozen ground is useful for forestry, mining, oil exploration, construction, and military operations. Guidelines for estimating the frost depth necessary to support a given vehicle load have been generated based on experience in forestry operations on peatlands and similarities in the strength behavior of frozen peat and frozen soils. Correlation with information in the literature leads to a simple equation relating safe trafficability of frozen ground over soft ground: $P=Cz^2$, where P is the maximum load and C is a constant depending on the strength of the frozen layer, which has a thickness z. Values for the constant C and a chart showing required frozen thickness for a variety of vehicles are given.

MP 3641

SHORT-PERIOD VELOCITY FLUCTUATIONS OF TWO GLACIERS ON MT. WRANGELL, ALASKA.

Sturm, M., *Physical geography*, Jan.-Feb. 1995, 16(1), p.42-58, 27 refs.

49-6093

GLACIER FLOW, GLACIER SURVEYS, GLACIER OSCILLATION, GLACIAL HYDROLOGY, MELTWATER, VELOCITY MEASUREMENT, PERIODIC VARIATIONS, VOLCANOES, GEOTHERMAL THAWING, UNITED STATES—ALASKA—WRANGELL, MOUNT

Mt. Wrangell, a glacier-covered volcano, has experienced increased heat flow since 1964. Coincident with this, glaciers on the northeast flank of the volcano began advancing. In 1981, a similar study was conducted on a glacier on the west flank. The west-flank glacier flowed faster and experienced five times greater fluctuations in velocity than the northeast-flank glacier. These fluctuations were generally synchronous throughout the lower part of the glacier, but asynchronous fluctuations were observed to propagate both up- and down-glacier. Periods of increased velocity coincided with uplift of the glacier surface (up

to 10 cm); periods of decreased velocity followed abrupt surface subsidence. Changes in the velocity of the northeast-flank glacier were less coherent spatially, and significant movement of the glacier surface did not occur. The different styles of motion of the two glaciers may reflect fundamental differences in their subglacial water systems, or differences in the time of year of the studies. It also is possible that subglacial volcanic heating on the northeast flank of the volcano affected the flow.

MP 3642
MONTE CARLO SIMULATION TO ESTIMATE NORTHERN SEA ROUTE TRANSIT TIME AND COST.

Mulherin, N.D., Smith, O.P., Eppler, D.T., Proshutinski, T.O., International Conference on Port and Ocean Engineering under Arctic Conditions, 13th, Murmansk, Russia, Aug. 15-18, 1995. Proceedings. POAC 95. Vol.1, St. Petersburg, 1995, p.200-201. 49-6247

MARINE TRANSPORTATION, COST ANALYSIS, COMPUTERIZED SIMULATION, MATHEMATICAL MODELS, ICE NAVIGATION, NORTHERN SEA ROUTE

MP 3643
COLLECTION AND CURATION OF IDPS IN THE STRATOSPHERE AND BELOW. PART 2: THE GREENLAND AND ANTARCTIC ICE SHEETS.

Maurette, M., Hammer, C., Harvey, R., Immel, G., Kurat, G., Taylor, S., *Lunar and Planetary Institute, Houston, TX. Technical report*, 1994, LP/TR-94-02, Workshop on the Analysis of Interplanetary Dust Particles, Houston, TX, May 15-17, 1993, p.36-40, N95-10962, 24 refs. 49-6317

ICE SHEETS, ICE COMPOSITION, ARTIFICIAL MELTING, MELTWATER, IMPURITIES, COSMIC DUST
The recovery of unmelted to partially melted 50-400 μm -sized IDPs (interplanetary dust particles) from the Greenland and antarctic ice sheets is described. Ice samples are melted in the field by steam generators and pumped through sieves to obtain IDPs. More than 40,000 IDPs have been recovered from 360 tons of ice at Cap Prudhomme, Antarctica, grouped in four size fractions (25-50, 50-100, 100-400, and >400 μm), but mostly in the 50-100 μm -size fraction, and are now stored at CSNSM (Centre de Spectrométrie Nucléaire et de Spectrométrie de Masse) in Orsay, France. This is the purest and richest sample of IDPs ever extracted from terrestrial sediments.

MP 3644
MODEL FOR THE ANELASTIC STRAINING OF SALINE ICE SUBJECTED TO CYCLIC LOADING.

Cole, D.M., *Philosophical magazine A*, 1995, 72(1), p.231-248, 35 refs. 49-6331

SEA ICE, SALT ICE, ICE MODELS, ICE MECHANICS, STRAIN TESTS, ICE RELAXATION, DISLOCATIONS (MATERIALS), DYNAMIC LOADS, POROSITY, TEMPERATURE EFFECTS

This work formulates a model of the anelastic response of saline ice based on dislocation and grain-boundary relaxations. The dislocation-based mechanism generally dominates the behavior, having a relaxation strength of approximately an order of magnitude greater than the grain-boundary relaxation. The latter process explains the anelasticity observed at higher frequencies and lower temperatures. An expression for the oscillatory motion of basal plane dislocations is developed that derives its temperature dependence from the dislocation drag term, which is found to be approximately the same as in freshwater ice. Predictions of transient and steady-state cyclic loading behavior are examined in detail and compared with experimental observations. Aspects of the model that are still under development, related primarily to temperature effects on the microstructure and the incorporation of explicit microstructural parameters, are also discussed.

MP 3645
SUPERSTRUCTURE SPRAY AND ICE ACCRETION ON A LARGE U.S. COAST GUARD CUTTER.

Ryerson, C.C., *Atmospheric research*, 1995, Vol.36, p.321-337, 34 refs. For another version see 48-855. 49-6332

MARINE METEOROLOGY, CLOUD PHYSICS, SHIP ICING, SPRAY FREEZING, SUPERSTRUCTURES, ICE SOLID INTERFACE, ICE ACCRETION, ABLATION, CLOUD DROPLETS, STATISTICAL ANALYSIS

Superstructure spray flux and ice accretion were measured on a 115 m Coast Guard cutter in the North Pacific Ocean and the Bering Sea during Feb. and Mar. 1990. This was the first such measurement cruise on a large ship; all previous measurements have been on trawlers and patrol boats. The drop number concentration of most spray clouds was high, ranging from 2.0×10^5 to 3.0×10^5 drops/ m^3 . Spray cloud drop sizes ranged from 14 to 770 μm , with geometric median of 234 μm . Spray cloud liquid water

contents had a very large range with a mean of 64.1 g/ m^3 . Ice accretion rates were low, but sufficient to observe greater ice thicknesses on decks than on bulkheads. The ice accretion process was also found to be extremely dynamic, alternately accreting and ablating several times before reaching maximum thickness. No simple relationships were found between time-series of ice thickness during two icing events and controlling environmental parameters.

MP 3646
LASER SCANNING OF NATURAL AND ARTIFICIAL SNOW PACKS.

Itagaki, K., Lemieux, G.E., Ji, N., Material Research Society Symposium Proceedings. Vol.367, Materials Research Society, 1995, p.379-384, 7 refs. 49-6333

SNOW COVER STRUCTURE, PHYSICAL PROPERTIES, SIMULATION, SNOW OPTICS, LASERS, IMAGING, LIGHT TRANSMISSION, STATISTICAL ANALYSIS
In an effort to numerically describe a snow pack as a disordered aggregate of irregularly shaped particles, a new optical analysis system was conceived. The system measured light transmission through snow samples impregnated with an opaque fluid. An analysis of the results is presented.

MP 3647
EFFECT OF CHANGE IN THERMAL PROPERTIES ON THE PROPAGATION OF A PERIODIC THERMAL WAVE: APPLICATION TO A SNOW-BURIED ROCKY OUTCROP.

Gray, J.M.N.T., Morland, L.W., Colbeck, S.C., *Journal of geophysical research*, Aug. 10, 1995, 100(B8), p.15,267-15,279, 18 refs. 49-6334

SNOW COVER STABILITY, THERMAL REGIME, SURFACE TEMPERATURE, TEMPERATURE DISTRIBUTION, WAVE PROPAGATION, SNOW THERMAL PROPERTIES, ICE SOLID INTERFACE, ROCKS, SUBSURFACE INVESTIGATIONS, HEAT BALANCE, HEAT TRANSFER, MATHEMATICAL MODELS, AVALANCHE FORECASTING
The propagation of a periodic thermal wave into snow is significantly altered by the presence of a shallow rock interface because of the large difference in thermal properties of the two media. The temperature distribution is modeled using classical heat conduction equations subject to a periodic diurnal or seasonal surface heat flux condition, jump conditions at the interface, and insulating conditions in the far-field. If the interface lies close to or within the skin depth then large temperature gradients can be sustained in the snow before temperature oscillations are forced through to the underlying rock. These features are explained by an analytic one-dimensional periodic solution. A numerical algorithm is constructed to solve for the temperature around plane two-dimensional rock geometries. The results show that during a period of atmospheric cooling the presence of a buried rocky outcrop increases the snow temperature and temperature gradients simultaneously to produce very favorable conditions for crystal growth and avalanche formation.

MP 3648
IN-SITU AND LABORATORY MEASUREMENTS OF THE PHYSICAL AND MECHANICAL PROPERTIES OF FIRST-YEAR SEA ICE.

Cole, D.M., et al, Ice mechanics—1995. AMD-Vol.207. Edited by J.P. Dempsey and Y.D.S. Rajapakse, New York, American Society of Mechanical Engineers. Applied Mechanics Division, 1995, p.161-178, 16 refs. 49-6365

ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE DEFORMATION, ICE CREEP, ICE ELASTICITY, ICE CRACKS, ICE MICROSTRUCTURE, UNITED STATES—ALASKA—BARROW

This paper presents an overview of a set of field and laboratory measurements made to investigate the evolution of the physical and mechanical properties of first-year sea ice through a growth season. The primary objectives of the study were 1) to examine the influence of sample size on the strength and constitutive behavior of first-year sea ice through in-situ experiments, 2) to improve understanding of the interrelations between physical and mechanical properties, and 3) to verify models based on small-scale isothermal behavior. To address these concerns for young, mid-winter and spring conditions, replicate sets of loading experiments and physical properties observations were made in Nov. 1993, Mar. 1994, and May 1994. Each set consisted of in-situ fracture, creep, creep recovery and cyclic loading experiments at a site in Elson Lagoon, near Barrow, AK, and laboratory measurements of flexural strength. Physical properties characterization included profiles of salinity, fabric, density, grain size and platelet spacing for each set of experiments.

MP 3649
EFFECT OF C-AXIS ALIGNMENT ON THE CONSTITUTIVE BEHAVIOR OF SEA ICE AT LOW STRAINS.

Cole, D.M., Durrell, G.D., Ice mechanics—1995. AMD-Vol.207. Edited by J.P. Dempsey and Y.D.S.

Rajapakse, New York, American Society of Mechanical Engineers. Applied Mechanics Division, 1995, p.189-199, 15 refs. 49-6367

ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE DEFORMATION, ICE ELASTICITY, ICE STRUCTURE, STRAIN TESTS, UNITED STATES—ALASKA—BARROW
This paper gives the results of laboratory cyclic loading experiments on horizontal cores from aligned sea ice. The cores, taken parallel, perpendicular and at 45° to the preferred c-axis direction, were harvested early in the growth season from a 0.3-m thick sheet in the Alaskan Arctic. The experiments examined the constitutive behavior under reversed direct-stress conditions for 10^{-3} to 10 Hz, peak stresses between 0.1 and 0.4 MPa, and temperatures between -3 and -10°C. Significant orientation effects emerged on the effective elastic and anelastic components of deformation and they are examined in terms of the underlying micromechanical processes. The paper presents crystallographic information and micrographs that give useful insight into the size and spatial distribution of the brine- and gas-filled voids. This work is part of a larger program to examine the evolution of the physical and mechanical properties of arctic sea ice during an annual cycle.

MP 3650
ICE PILE-UP PROBLEM: A COMPARISON BETWEEN EXPERIMENTS AND SIMULATIONS.

Hopkins, M.A., Ice mechanics—1995. AMD-Vol.207. Edited by J.P. Dempsey and Y.D.S. Rajapakse, New York, American Society of Mechanical Engineers. Applied Mechanics Division, 1995, p.211-218, 3 refs. 49-6369

ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE DEFORMATION, ICE PILEUP, ICE OVERRIDE, ENVIRONMENTAL TESTS, COMPUTERIZED SIMULATION
Onshore pile-up of river ice and sea ice is common on northern rivers and around arctic seas. The forces exerted by the ice during pile-up may damage embankments and structures. Physical experiments were performed in which a moving inclined ramp was pushed against a long stationary strip of intact floating ice. The forces exerted on the structure, the total energy expended, and the change in the potential energy of the ice were measured in each experiment. A parallel set of experiments were performed using a discrete element computer model and measured ice properties. A direct comparison between the two sets of results shows that the simulation closely approximates the physical experiments.

MP 3651
STRESS ANALYSIS OF A PROPOSED TUNNEL UNDER THE SOUTH POLE SKIWAY.

Sodhi, D.S., Rand, J.H., Tobiasson, W., International Design for Extreme Environment Assembly, 2nd, Montreal, Oct. 24-27, 1993. Growth and Environment: challenging extreme frontiers; IDEEA Two conference proceedings, Montreal, Canada, 1994, p.57-66, 8 refs. 49-6379

SNOW TUNNELS, SNOW ELASTICITY, SNOW STRENGTH, STRESSES, ANTARCTICA—AMUNDSEN-SCOTT STATION

Unlined tunnels in the snow at the Amundsen-Scott Station will be used for safe movement of personnel to satellite science buildings during the austral winter. The first 1.8 m wide x 3 m high tunnel will pass under the existing skiway. This study determined the depth at which that tunnel should be located so that it is safe when aircraft pass over it. Three efforts were undertaken: (a) conducting a three-dimensional, elastic stress analysis of the snow around the tunnel, (b) comparing the maximum tensile and shear stresses from that analysis with corresponding strengths published in the literature, and (c) performing two experiments at South Pole to determine the surface pressure required to fail the snow around model tunnels. The authors found general agreement of theoretical and experimental results and recommended that the roof of the tunnel be located at least 6.1 m below the surface of the skiway. (Auth.)

MP 3652
ANALYSIS OF THE WINTER LOW-FLOW BALANCE OF THE SEMIARID WHITE RIVER, NEBRASKA AND SOUTH DAKOTA.

Ferrick, M.G., Mulherin, N.D., Calkins, D.J., *Water resources research*, Aug. 1995, 31(8), p.1999-2009, 22 refs. 49-6405

RIVER BASINS, WATER SUPPLY, STREAM FLOW, HYDROGRAPHY, RIVER ICE, WATER BALANCE, FLOW MEASUREMENT, ICE (WATER STORAGE), ICE COVER EFFECT, GROUND WATER, SEASONAL VARIATIONS, ANALYSIS (MATHEMATICS), UNITED STATES—NEBRASKA

The low-flow water balance of a river in a cold region is simplified in winter because evapotranspiration is negligible, irrigation water withdrawals and diversions are halted, and precipitation

occurs largely as snow, minimizing the spatial and temporal variability of runoff. The authors investigated monthly low-flow water balance of White River reaches over seven consecutive winters. Water going into or out of storage as ice or melt, obtained with an air temperature index model, can be a dominant component of the water balance. The point estimate method is used to account for parameter uncertainty and variability providing the mean, variance, and limits of dependent variables such as water storage as ice and inflow from a subbasin. Negative surface water yield from several-thousand km subbasins occurred regularly through the period, indicating a significant flow from the river to the alluvial aquifers. The winter water balance results suggest either a perched river or a coupled surface water-groundwater hydrologic system in particular subbasins, consistent with the field investigations of Rothrock (1942). The winter flow exchange between the surface and subsurface can be used to estimate the annual exchange for both hydrologic conditions.

MP 3653
APPLICATION OF REMOTE SENSING FOR NATURAL AND CULTURAL RESOURCE MANAGEMENT. FINAL REPORT.

Jarrett, J.L., et al, Aberdeen Proving Ground, MD, U.S. Army Environmental Center, 1995, Var. p., Refs. passim. Report on a workshop sponsored by the U.S. Army Corps of Engineers at Fort Belvoir, VA, Apr. 19-20, 1995.

49-6323

MILITARY FACILITIES, SITE SURVEYS, VEGETATION PATTERNS, SOIL SURVEYS, SOIL CONSERVATION, LAND RECLAMATION, REGIONAL PLANNING, REMOTE SENSING, AERIAL SURVEYS, SPACEBORNE PHOTOGRAPHY

MP 3654
PERMITTIVITY OF SEA ICE AT KA-BAND.

Lytle, V.I., Ackley, S.F., International Geoscience and Remote Sensing Symposium, Firenze (Florence), Italy, July 10-14, 1995. IGARSS'95. Quantitative remote sensing for science and applications. Vol.1, New York, Institute of Electrical and Electronics Engineers, 1995, p.410-413, 4 refs.

49-6517

ICE SURVEYS, SEA ICE, ICE DIELECTRICS, ICE ELECTRICAL PROPERTIES, ICE STRUCTURE, ICE GROWTH, BRINES, RADIO ECHO SOUNDINGS
Measurements of the complex permittivity of sea ice at Ka-Band (26.5 to 40 GHz) were collected in the CRREL laboratory using a step frequency radar. Columnar and granular sea ice samples were prepared from cores of laboratory-grown sea ice sheets with salinities ranging from 3 to 8 ppt. The authors measured the permittivity at temperatures from -30 to -12 C in three orthogonal directions. It was found for all samples that the imaginary part of the dielectric constant is highly dependent on the brine volume of the sea ice, which in turn depends on the bulk salinity and the temperature of the sample. For columnar ice, consisting of approximately ellipsoidal brine pockets embedded in an ice matrix, the imaginary part of the dielectric constant was anisotropic, and depended on the relative orientation of the electric field and the axes of the brine pockets. The highest values of the imaginary part of the permittivity were measured when the electric field was oriented parallel to the direction of ice growth, or along the longest axes of the brine pockets.

MP 3655
EFFECT OF ICE-SHEET THICKNESS CHANGE ON THE ACCUMULATION HISTORY INFERRED FROM GISP2 LAYER THICKNESSES.

Cutler, N.N., Raymond, C.F., Waddington, E.D., Meese, D.A., Alley, R.B., *Annals of glaciology*, 1995, Vol.21, International Symposium on the Role of the Cryosphere in Global Change, Columbus, OH, Aug. 7-12, 1994. Proceedings. Edited by D.A. Rothrock, p.26-32, 21 refs.

49-6584

ICE SHEETS, GLACIER THICKNESS, GLACIER OSCILLATION, GLACIER FLOW, GLACIER ALIMENTATION, ICE CORES, FIRN STRATIFICATION, SNOW ICE INTERFACE, SNOW STRATIGRAPHY, PALEOCLIMATOLOGY, GREENLAND

Net accumulation rates at the Greenland summit have been inferred using layer-thickness data from the GISP2 ice core with corrections for strain using a non-linear, one-dimensional flow model of an ice sheet. The flow model accounts for thickness changes in ice-sheet in response to mass-balance variations. The model is used to investigate how net accumulation-rate changes affect the time evolution of: (1) ice thickness, (2) vertical strain rate, and (3) the corresponding internal annual-layer structure. The model, parameterized to fit the present net accumulation rate and thickness of the Greenland ice-sheet summit, has a characteristic time constant for adjustment to accumulation-rate changes of about 6000 a and yields an ice sheet 200-400 m thinner than its present thickness during the last glacial period. Accumulation-rate histories inferred from GISP2 layer-thickness data using both a constant- and a variable-thickness model are compared. The

variable-thickness model predicts accumulation rates about 25% lower than the constant-thickness model. Results also indicate that high-frequency changes in accumulation rates (i.e. after the Younger Dryas event) are consistent with earlier analyses.

MP 3656
CONSTRAINTS ON HOLOCENE ICE-THICKNESS CHANGES IN CENTRAL GREENLAND FROM THE GISP2 ICE-CORE DATA.

Bolzan, J.F., Waddington, E.D., Alley, R.B., Meese, D.A., *Annals of glaciology*, 1995, Vol.21, International Symposium on the Role of the Cryosphere in Global Change, Columbus, OH, Aug. 7-12, 1994. Proceedings. Edited by D.A. Rothrock, p.33-39, 17 refs.

49-6585

ICE SHEETS, GLACIER THICKNESS, GLACIER OSCILLATION, GLACIER FLOW, GLACIER ALIMENTATION, ICE CORES, ICE DATING, FIRN STRATIFICATION, SNOW ICE INTERFACE, SNOW STRATIGRAPHY, PALEOCLIMATOLOGY, GREENLAND

The depth-age relation observed in the GISP2 ice core is the result of the integrated effects of ice-sheet changes over time, as well as the accumulation-rate history. Here the authors construct a forward model to compute ages at various depths in the core. In the model, these ages are functions of parameters that describe the ice thickness as a function of time. Using the maximum-likelihood inverse method, these parameters are iteratively adjusted until measured and computed ages agree satisfactorily. The results suggest that the thickness along the flowline connecting the GISP2 and GRIP drill sites has not changed significantly since the onset of the Holocene.

MP 3657
INNOVATIVE INSTRUMENTATION FOR A PHYSICAL MODEL OF RIVER ICE TRANSPORT.

Larsen, J., Zufelt, J.E., Crissman, R.D., Symposium on Fundamentals and Advancements in Hydraulic Measurements and Experimentation, Buffalo, NY, Aug. 1-5, 1994. Proceedings, New York, American Society of Civil Engineers, 1994, p.259-267, 2 refs.

49-6734

RIVER ICE, ICE JAMS, ICE CONTROL, RIVER FLOW, FLOW CONTROL, WATER INTAKES, HYDRAULIC STRUCTURES, ENVIRONMENTAL TESTS, NIAGARA RIVER

Large physical models often require the use of innovative instrumentation and measurement techniques. Hydraulic models that attempt to simulate the effects of stationary ice covers put constraints on the types of instrumentation that can be used to successfully measure water velocities and stages. Ice transport models compound these measurement problems, since the motion of the ice is one of the primary variables of interest. The challenges of measuring the thickness, velocity, and concentration of moving ice in the field are significant. The challenges are only marginally easier in a physical model. These obstacles were addressed in a physical model study of the ice transport processes in the Grass Island Pool of the Upper Niagara River, which forms part of the border between the State of New York and the Province of Ontario.

MP 3658
H-BOND ACIDITY OF SOLVENTS: II, TRANSFORMATION OF THE SNYDER CHI PROTON DONOR SCALE TO THE TAFT-KAMLET ALPHA SCALE.

Leggett, D.C., *Journal of solution chemistry*, 1994, 23(6), p.697-701, 10 refs.

49-6742

SOLUTIONS, SOLUBILITY, HYDROGEN BONDS, PROTON TRANSPORT, CHEMICAL PROPERTIES, CHEMICAL ANALYSIS

By including a solvent cohesion term it was possible to transform Snyder's χ_d scale into the Taft-Kamlet α scale for aliphatic H-bonding solvents. The transforming equation was: $\alpha = 2.386\chi_d + 1.271\alpha\beta - 0.482$ where $\alpha\beta$ is the product of solvent acidity and basicity. Alpha is estimated for several solvents previously not thought to possess H-donor ability. These are dimethyl sulfoxide, nitroethane, dimethylformamide, dioxane, dimethylacetamide, propylene carbonate, ethyl acetate, butyrolactone, N-methylpyrrolidinone, and cyclohexanone.

MP 3659
GPR FOR UNDERGROUND DETECTION.

Arcone, S.A., *Military engineer*, Aug.-Sep. 1995, 87(572), p.18-20.

49-6743

SOIL POLLUTION, WATER POLLUTION, OIL SPILLS, GROUND WATER, SUBSURFACE INVESTIGATIONS, ELECTROMAGNETIC PROSPECTING, MILITARY FACILITIES, RADAR

MP 3660
ANALYTICAL METHODS FOR WHITE PHOSPHORUS (P₄) IN SEDIMENT AND WATER.

Walsh, M.E., Taylor, S.T., Anderson, D., McCarty, H., Waste Testing and Quality Assurance Symposium, 11th, Washington, D.C., July 23-28, 1995. Proceedings, Philadelphia, American Society for Testing and Materials (ASTM), 1995, p.380-387, 16 refs.

49-6745

SOIL POLLUTION, WATER POLLUTION, SOIL CHEMISTRY, WATER CHEMISTRY, CHEMICAL ANALYSIS, EXPLOSIVES

White phosphorus (P₄) can produce severe adverse ecological impacts if released into the environment. To date, there is no standard analytical method for detecting white phosphorus in environmental matrices. The authors have been using an analytical method based on solvent extraction and gas chromatography to determine white phosphorus in sediments and water from an Army training area. For sediments, a threshold of less than 1 µg/kg was achieved for white phosphorus extracted with isooctane and determined with a portable capillary gas chromatograph equipped with a nitrogen-phosphorus detector. For water, extraction with isooctane may be used to determine concentrations greater than 0.1 µg/L. With a diethyl ether preconcentration procedure, a detection threshold of less than 0.01 µg/L was achieved.

MP 3661
SUITABILITY OF POLYMERIC TUBINGS FOR SAMPLING WELL WATER TO BE ANALYZED FOR TRACE-LEVEL ORGANICS.

Parker, L.V., Ranney, T.A., Waste Testing and Quality Assurance Symposium, 11th, Washington, D.C., July 23-28, 1995. Proceedings, Philadelphia, American Society for Testing and Materials (ASTM), 1995, p.305-314, 17 refs.

49-6746

SOIL POLLUTION, WATER POLLUTION, GROUND WATER, SOIL CHEMISTRY, WATER CHEMISTRY, CHEMICAL ANALYSIS, WELLS, WELL CASINGS

There is concern in the groundwater monitoring industry that polymeric tubings used to sample groundwater can affect contaminant concentrations. Results from a recent study that looked for sorption and leaching of organic contaminants by twenty polymeric tubings will be presented. The flexible and rigid tubings tested included several polyethylene and polypropylene formulations, several different fluoropolymers, as well as polyurethane, polyamide, and flexible PVC. Based on the findings from this study and relative cost, the authors tentatively recommend PVDF when a rigid tubing can be used and a copolymer of vinylidene fluoride and hexafluoropropylene [P(VDF-HFP)] when a more flexible tubing is required. However, since this study was conducted under static conditions, and sampling usually involves continual replenishment of the contacting solution, studies under dynamic conditions are currently being conducted.

MP 3662
DETERMINING VOLATILE ORGANIC COMPOUND CONCENTRATION STABILITY IN SOIL.

Hewitt, A.D., Waste Testing and Quality Assurance Symposium, 11th, Washington, D.C., July 23-28, 1995. Proceedings, Philadelphia, American Society for Testing and Materials (ASTM), 1995, p.173-183, 18 refs.

49-6747

SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, CHEMICAL ANALYSIS

The pre-analysis concentration stability of volatile organic compounds (VOCs) in soil matrices was evaluated independent of volatilization losses. Soil subsamples were fortified with benzene, toluene, ethyl benzene, p-xylene, o-xylene, trans-1,2-dichloroethylene, trichloroethylene and perchloroethylene, sealed inside glass ampoules and handled in a manner consistent with the EPA's SW-846 Method 8240. Experiments have repeatedly shown that chlorinated-hydrocarbon concentrations remain fairly constant, while aromatic hydrocarbons often experience a complete (>99%) loss when soils are held at 22°C for several days. While refrigeration at 4°C reduces the rate of biodegradation, more than 50% of some hydrocarbons are lost when soils are held for 14 days. Chemical preservation by soil acidification with NaHSO₄ mitigates the loss of these aromatic hydrocarbons for periods beyond 14 days when held at 22°C.

MP 3663
EVALUATION OF THE NEW CLEAN SOLID PHASES FOR EXTRACTION OF NITROAROMATICS AND NITRAMINES FROM WATER.

Jenkins, T.F., Thorne, P.G., Myers, K.F., McCormick, E.F., Waste Testing and Quality Assurance Symposium, 11th, Washington, D.C., July 23-28, 1995. Proceedings, Philadelphia, American Society for Testing and Materials (ASTM), 1995, p.128-142, 17 refs.

49-6748

SOIL POLLUTION, WATER POLLUTION, GROUND

WATER, SOIL CHEMISTRY, WATER CHEMISTRY, EXPLOSIVES, CHEMICAL ANALYSIS, MILITARY FACILITIES
Salting-out solvent extraction (SOE) is the preconcentration step currently specified in SW846 Method 8330, the reversed-phase high-performance liquid chromatography (RP-HPLC) method for nitroaromatics and nitramines in water. Previous attempts to utilize solid phase extraction (SPE) in the laboratory indicated that use of the solid phases commercially available at the time led to introduction of unacceptable interferences for some matrices. Recently, several manufacturers have introduced new cleaner solid phases. This study was conducted to evaluate their utility in providing preconcentration for low level determination of these analytes.

**MP 3664
SPOT SURVEY OF WILD RICE IN NORTHERN MINNESOTA.**

Bolus, R.L., *Journal of imaging science and technology*, Dec. 1994, 38(6), p.594-597, 5 refs.
49-6749

WETLANDS, VEGETATION PATTERNS, PLANT ECOLOGY, BIOGEOGRAPHY, TERRAIN IDENTIFICATION, SPACEBORNE PHOTOGRAPHY, IMAGE PROCESSING, UNITED STATES—MINNESOTA

A survey of the areal extent of wild rice around three lakes in northern Minnesota has been conducted. Wild rice is a desirable natural marsh grass that is sensitive not only to the phosphorus washed from farm, urban, and industrial areas, but also to water level. The objective of the survey was to produce a geographic information system map from the remotely sensed Satellite Pour l'Observation de la Terre (SPOT) data, showing identification and location of the wild rice on a Chippewa reservation and listing its acreage. The approach used was the technique of supervised spectral classification. The results surprisingly show three distinct and separate spectral populations of wild rice. Although it is unrealistic that different varieties are growing in close proximity, some possible causes for the results are that (1) dissimilar land cover backgrounds are causing different mixed pixel responses, (2) varying crop canopies are causing different detected radiance, and (3) varying water content of the vegetation is causing radiance differences.

**MP 3665
ICE EFFECTS ON RIPRAP.**

Wuebben, J.L., River, coastal and shoreline protection: erosion control using riprap and armourstone, Chichester, England, John Wiley & Sons, Ltd., 1995, p.513-530, 33 refs.
49-6751

RIVER ICE, ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE PUSH, ICE OVERRIDE, ICE PILEUP, ICE EROSION, ROCK FILLS, BANK PROTECTION (WATERWAYS)

Riprap structures are customarily designed to withstand forces from water currents and wave action. However, when such structures are built in ice-prone areas, their design must also take into consideration those forces induced by ice formation and movement, as well as the effect of freeze-thaw processes. Ice formation and breakup can affect the performance of riprap structures in a number of ways, depending on the environmental driving forces and the physical characteristics of the ice and riprap structure. In this paper, the modes of direct ice action on riprap and the influence of ice-affected river hydraulics are outlined, and information on the magnitude of ice-related forces and the effects of seasonal freezing on installation integrity are presented.

**MP 3666
SHOOT AND ROOT DEVELOPMENT OF TALL AND HARD FESCUES IN TWO DIFFERENT SOILS.**

Brar, G.S., Palazzo, A.J., *Journal of environmental quality*, July-Aug. 1995, 24(4), p.777-781, 38 refs.
49-6755

GRASSES, ROOTS, REVEGETATION, LAND RECLAMATION, SOIL CONSERVATION, SOIL STABILIZATION
Tall (*Festuca arundinacea* Schreb.) and hard fescue [*Festuca ovina* var. *longifolia* (L.) Koch] are among the most widely sown grasses used to stabilize disturbed soils in both the cool-humid and transition climatic zones of the US. The present objective was to evaluate the root and shoot development of two turfgrasses grown in sand and silt loam soils. Significant differences in leaf area, plant height, shoot and root dry matter, root depth (RD), root branching (RB), and root length (RL) were recorded, tall fescue being compared with hard fescue. Greater leaf area, leaf number, plant height, shoot and root dry matter, and RL were observed when the grasses were grown in a silt loam soil. Greater RD and root/shoot ratio were recorded in sandy soil. Both turfgrass species and soil texture affected leaf area, leaf number, plant height, shoot dry matter, RD, RL, RB, root dry matter, and the root/shoot ratio. Significant correlations were obtained for shoot dry matter with root dry matter and RL; leaf area with shoot dry matter and root dry matter; root dry matter with TRL and RB; RD with root/shoot ratio; RL with leaf area; and RB with TRL and RD. Turfgrasses and soil types had a significant impact on shoot and root development.

**MP 3667
RECENT INCREASE IN SOUTH POLE SNOW ACCUMULATION.**

Mosley-Thompson, E., et al, *Annals of glaciology*, 1995, Vol.21, International Symposium on the Role of the Cryosphere in Global Change, Columbus, OH, Aug. 7-12, 1994. Proceedings. Edited by D.A. Rothrock, p.131-138, 26 refs.
49-6600

ICE SHEETS, GLACIER OSCILLATION, GLACIER MASS BALANCE, GLACIER ALIMENTATION, GLACIAL METEOROLOGY, GLACIER SURVEYS, SNOW ICE INTERFACE, SNOW ACCUMULATION, SNOW SURVEYS, SNOW WATER EQUIVALENT, GLOBAL WARMING, ANTARCTICA—AMUNDSEN-SCOTT STATION

This paper summarizes the 37 year history of net accumulation measurements at the geographic South Pole obtained by numerous investigators using a variety of techniques. These data led to the conclusion that annual net snow accumulation has increased in the vicinity of Amundsen-Scott Station since 1958. The records were examined for evidence of a "station effect" but it is concluded that not all of the observed increase can be attributed to snow drift associated with the presence of the station. Furthermore, the accumulation increase at South Pole appears consistent with increases observed at other locations on the East Antarctic Plateau, and in the Peninsula region as well. These data suggest that the recent accumulation increase at Amundsen-Scott Station may be regionally extensive over the East Antarctic Plateau. (Auth.)

**MP 3668
SOIL DEFORMATION AND STRESS ANALYSIS UNDER A ROLLING WHEEL.**

Foster, W.A., Jr., Johnson, C.E., Raper, R.L., Shoop, S.A., North American Conference/Workshop of ISTVS (International Society for Terrain-Vehicle Systems), 5th, Saskatoon, Saskatchewan, May 10-12, 1995. Proceedings. Advanced technology in vehicle-terrain interaction, Hanover, NH, International Society for Terrain-Vehicle Systems (ISTVS), 1995, p.194-203, 5 refs.
50-47

ALL TERRAIN VEHICLES, VEHICLE WHEELS, SOIL STRENGTH, SOIL TRAFFICABILITY, SOIL COMPACTION, SOIL TESTS, STRAIN TESTS, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION

The work presented in this paper describes the development of a nonlinear finite element model for predicting deformations and stress distributions in soils caused by a wheel rolling over the surface of the soil. The finite element model includes both geometric and material nonlinear behavior. The wheel's motion is simulated using enforced displacements on the soil surface. The results obtained from the analysis are compared to an existing experimental database. The agreement between analysis and experimental data is shown to be very good in most respects.

**MP 3669
METHODOLOGY FOR PREDICTING FOR WINTER CONDITIONS IN THE NATO REFERENCE MOBILITY MODEL.**

Ahlvin, R.B., Shoop, S.A., North American Conference/Workshop of ISTVS (International Society for Terrain-Vehicle Systems), 5th, Saskatoon, Saskatchewan, May 10-12, 1995. Proceedings. Advanced technology in vehicle-terrain interaction, Hanover, NH, International Society for Terrain-Vehicle Systems (ISTVS), 1995, p.320-334, 12 refs.
50-48

ALL TERRAIN VEHICLES, SNOW VEHICLES, VEHICLE WHEELS, TRACKED VEHICLES, RUBBER SNOW FRICTION, SNOW STRENGTH, SOIL STRENGTH, TRACTION, TRAFFICABILITY, COMPUTER PROGRAMS

The NATO Reference Mobility Model, now in its second release (NRMM II), is a comprehensive computer model that predicts vehicle speed performance for operation on roads, trails and cross-country in all types of weather conditions, including snow cover. Presently, the winter condition in NRMM II is limited specifically to shallow snow on hard frozen ground (referred to herein as the "original" model). This paper discusses methods of incorporating recent work performed by the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) in NRMM II. These developments extend the simulation capabilities to include snow cover on unfrozen, partially frozen, and ice covered surfaces; a deep snow condition; thawing soils; and ice surfaces with no snow cover.

**MP 3670
OBSERVATIONS OF SNOW DEFORMATION BY A WHEEL.**

Richmond, P.W., North American Conference/Workshop of ISTVS (International Society for Terrain-Vehicle Systems), 5th, Saskatoon, Saskatchewan, May 10-12, 1995. Proceedings. Advanced technology in vehicle-terrain interaction, Hanover, NH, Inter-

national Society for Terrain-Vehicle Systems (ISTVS), 1995, p.343-351, 4 refs.
50-49

SNOW VEHICLES, VEHICLE WHEELS, RUBBER SNOW FRICTION, SNOW STRENGTH, SNOW DEFORMATION, TRACTION, TRAFFICABILITY

The deformation of snow by a freely rolling wheel is a complex three-dimensional problem, which is further complicated by the variability of the snow itself. Models created for estimating mobility parameters in snow (e.g., motion resistance) must reflect the associated physical phenomena in their underlying equations and in the prediction results. An understanding of the physical deformation of snow by a wheel will provide information for the improvement and verification of current and future over-snow mobility models. A visualization technique using carpenter's chalk dust, inserted into 12.5-mm diameter holes punched into a snow cover, allowed the observation of the snow deformation caused by a wheel. By carefully removing the snow around the deformed holes, a complete visualization of the three-dimensional deformation was possible. Photographs of the deformation pattern and snow density measurements allowed a detailed analysis of the direction and extent of the deformation. Although the technique is primarily qualitative, some interesting phenomena were observed. Snow deformation occurs primarily at or below the level of the wheel rut in shallow snow and higher in the snow-pack if the snow is deep. Increasing wheel width does not seem to increase deformation in the direction perpendicular to vehicle motion, at least in the one comparison available from these tests.

**MP 3671
HELICOPTER-BORNE ALPINE GLACIER SURVEYS USING SHORT PULSE RADAR.**

Arcone, S.A., Delaney, A.J., Wills, R.H., *Canada. Geological Survey. Paper*, 1992, No.90-4, Ground penetrating radar. Edited by J.A. Pilon, p.25-32, With French summary. 9 refs.
50-55

MOUNTAIN GLACIERS, GLACIER SURVEYS, GLACIER THICKNESS, SUBGLACIAL OBSERVATIONS, GLACIER BEDS, BOTTOM TOPOGRAPHY, RADAR ECHOES, ELECTROMAGNETIC PROSPECTING, AIRBORNE RADAR, UNITED STATES—ALASKA—ALASKA RANGE

Helicopter-borne ground penetrating radar (GPR) surveys were performed in Mar. 1986 on two small tributaries to the Yanet Glacier in the Alaska Range. The purpose was to find out if the UHF range could be used to investigate small, cold glaciers where fractures and crevasses might be minimal. The GPR used a GSSI model 3102 antenna unit rated at 8 W peak radiated power at a pulse center frequency of approximately 500 MHz, which is considerably higher than that of conventional radio echo sounders. The glaciers were profiled for about 1 km along straight lines, starting at their termini where bedrock was exposed, and ending where the bottom returns were barely visible at more than 28 m depth. In one case, the analog graphic record revealed a linear bottom profile and predominantly homogeneous conditions within the ice sheet. Use of a geometric attenuation dependency correction of distance squared on the digitized records resulted in a calculated attenuation rate for absorption of near 0 dB/m for the peak value of the bottom returns, but about ± 3 dB/m for the total energy of the wavelet.

**MP 3672
IMPULSE RADAR STUDIES OF INTERFACE ROUGHNESS.**

Jezek, K.C., Arcone, S.A., Daly, S.F., Wills, R.H., *Canada. Geological Survey. Paper*, 1992, No.90-4, Ground penetrating radar. Edited by J.A. Pilon, p.107-115, With French summary. 8 refs.
50-60

ICE SURVEYS, RIVER ICE, ICE JAMS, ICE SURFACE, ICE COVER THICKNESS, ICE WATER INTERFACE, AIRBORNE RADAR, RADAR ECHOES

Recent progress by several investigators has led to improved methods for estimating interface roughness via wave scattering measurements. These techniques, already tested on sonar data, are based on a union of scalar scattering theory derived from the Helmholtz-Kirchoff integral with statistical representations of measured echo amplitude variations as have been employed to describe phenomena such as laser speckle. The usefulness of these methods has been in their ability to identify successfully parameters common to both the probabilistic and scattering formulations, which are also related to interface characteristics—such as the r.m.s. roughness, correlation function, and Fresnel reflection coefficient. This paper discusses the application of this approach with its possible advantages and limitations to impulse radar data. The authors model echo amplitude variations via the parameter gamma, defined by previous investigators as the ratio of the coherently to incoherently scattered energy. In this case, gamma is inversely proportional to the square of the wave number, the square of the r.m.s. roughness and integral of the surface correlation function. Gamma is evaluated for a set of typical system and surface parameters and then used to calculate probability density functions of echo amplitude.

MP 3673

ESTIMATING SEA ICE THICKNESS FROM IMPULSE RADAR SOUNDING TIME OF FLIGHT DATA.

Kovacs, A., Morey, R.M., Canada. *Geological Survey. Paper*, 1992, No.90-4, Ground penetrating radar. Edited by J.A. Pilon, p.117-124, With French summary. 1 ref.

50-61

ICE SURVEYS, SEA ICE, ICE FLOES, SNOW ICE INTERFACE, SNOW COVER EFFECT, ICE COVER THICKNESS, ICE WATER INTERFACE, ICE DIELECTRICS, RADAR ECHOES

Two floes of second year sea ice were probed using impulse radar sounding and direct drilling methods. The resulting two-way time of flight of the impulse radar electromagnetic wavelet, travelling from the surface to the ice "bottom" and back to the surface, was compared with snow and ice thickness data obtained from a drillhole. From this comparison, simple relationships are presented to estimate the thickness of sea ice, between about 1 to 8 m thick, with or without a snow cover. Relations are also presented that show the bulk or apparent dielectric constant of the ice floes versus ice thickness, again with or without the snow cover. The data revealed that the apparent dielectric constant of the sea ice decreased with increasing ice thickness from a value of about 7 for ice 1 m thick to about 3.5 for ice 6 m thick.

MP 3674

CREEP AND YIELD MODEL OF FROZEN SOIL UNDER TRIAXIAL COMPRESSION.

Fish, A.M., International Offshore and Polar Engineering Conference, 5th, Hague, Netherlands, June 11-16, 1995. Proceedings. Vol.1, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1995, p.473-481, 50 refs.

50-172

SOIL FREEZING, SOIL CREEP, FROZEN GROUND STRENGTH, FROZEN GROUND COMPRESSION, MATHEMATICAL MODELS

A combined creep and yield model has been developed for the entire (primary, secondary and tertiary) creep and the long-term strength of frozen soil under multiaxial stress at both constant stresses and constant strain rates by a single (unified) constitutive equation. Secondary creep is assumed to be an inflection point of a creep curve defining time to failure. Secondary creep rate is described by a new flow law, the stress function of which includes the first invariant of the stress tensor. The model consists of four principal elements: a constitutive equation, a viscous flow equation and a yield criterion, all united by a time-to-failure function. The yield criterion is selected either in the form of a parabolic (extended) von Mises-Drucker-Prager model or a parabolic (extended) Mohr-Coulomb rupture model (Fish, 1991). The criteria take into account that, at a certain magnitude of the mean normal stress (σ_{max}), the shear strength of frozen soil reaches a maximum. The yield criteria are included in the time-to-failure function, the shape parameters of which are independent of the loading regime. The model has been verified using test data on creep and the long-term strength of frozen soil under triaxial compression at -10°C.

MP 3675

CREEP OF SALINE ICE AT LOW STRESSES AND HIGH TEMPERATURES.

Richter-Menge, J.A., Cox, G.F.N., International Offshore and Polar Engineering Conference, 5th, Hague, Netherlands, June 11-16, 1995. Proceedings. Vol.2, Edited by J.S. Chung, M. Sayed, and A.M. Gresnigt, Golden, CO, International Society of Offshore and Polar Engineers (ISOPE), 1995, p.312-316, 21 refs.

50-179

SEA ICE, SALT ICE, ICE COVER STRENGTH, ICE CREEP, ICE DEFORMATION, ICE PRESSURE, ICE LOADS, ICE TEMPERATURE, STRAIN TESTS

In engineering design and material models the creep behavior of ice or ice-rich soils is typically represented by the single-term flow law, $\dot{\epsilon} = B\sigma^n$, where $n=3$. The applicability of this constitutive model has been demonstrated for stresses above 0.10 MPa by a number of investigators. This paper addresses whether it is appropriate to extend the use of this form of the flow law to cases where the applied stress is as low as 0.01 MPa. Data from creep tests done on saline ice samples at stresses ranging from 1.5 to 0.01 MPa and at a temperature of -2°C are presented. The analysis of the data suggests that, while the single-term flow law provides a good approximation, a two-term flow law more accurately represents the ice behavior under these conditions.

MP 3676

DURABILITY ISSUES OF FRP COMPOSITES IN OFFSHORE STRUCTURES.

Dutta, P.K., International Offshore and Polar Engineering Conference, 5th, Hague, Netherlands, June 11-16, 1995. Proceedings. Vol.4, Golden, CO, International Society of Offshore and Polar Engineers

(ISOPE), 1995, p.271-276, 14 refs.

50-217

OFFSHORE STRUCTURES, COMPOSITE MATERIALS, CONSTRUCTION MATERIALS, PLASTICS, FREEZE THAW TESTS, FROST RESISTANCE, THERMAL STRESSES

Fiber reinforced plastic (FRP) composites are attractive materials for construction of offshore structures. However, there are concerns about the durability of these materials in extreme environments. Temperature and moisture play a crucial role on the life cycle of these composites. Influence of alkaline and saline environment is also important. Ultraviolet rays, repetitive freezing and thawing, load cycling, and creep under sustained load are other important issues, as are fire hazards and flammability of the materials. This paper briefly summarizes the impact of all these factors on the durability of the FRP materials.

MP 3677

PRESSURE MELTING AND ICE SKATING.

Colbeck, S.C., *American journal of physics*, Oct. 1995, 63(10), p.888-890, 10 refs.

50-408

METAL ICE FRICTION, ICE SOLID INTERFACE, REGULATION, ICE MELTING, WATER FILMS, SLIDING

Pressure melting cannot be responsible for the low friction of ice. The pressure needed to reach the melting temperature is above the compressive failure stress and, if it did occur, high squeeze losses would result in very thin films. Pure liquid water cannot coexist with ice much below -20°C at any pressure and friction does not increase suddenly in that range. If frictional heating and pressure melting contribute equally, the length of the wetted contact could not exceed 15 μm at a speed of 5 m/s, which seems much too short. If pressure melting is the dominant process, the water films are less than 0.08 μm thick because of the high pressures.

MP 3678

HYDROLOGICAL DISCHARGES AND MOTION OF FELS AND BLACK RAPIDS GLACIERS, ALASKA, U.S.A.: IMPLICATIONS FOR THE STRUCTURE OF THEIR DRAINAGE SYSTEMS.

Raymond, C.F., Benedict, R.J., Harrison, W.D., Echelmeyer, K.A., Sturm, M., *Journal of glaciology*, 1995, 41(138), p.290-304, 37 refs.

50-451

GLACIOLOGY, GLACIER FLOW, GLACIAL HYDROLOGY, SUBGLACIAL DRAINAGE, FLOW MEASUREMENT, SEASONAL VARIATIONS, DIURNAL VARIATIONS, ICE WATER INTERFACE, CORRELATION, UNITED STATES—ALASKA—ALASKA RANGE

This paper compares Black Rapids and Fels Glaciers in the central Alaska Range using high-resolution time series of a number of hydrological and ice-dynamical parameters that extend through much or all of the year for several years. On each glacier, it is possible to examine the relationships among these parameters on a variety of time-scales spanning short events of hours or less, diurnal variations, seasonal patterns and year-to-year changes. The relative timing of dynamic events on the glaciers and discharges of water, solutes and sediments are of particular interest in examining the structure of the drainage system and its relation to the ice flow.

MP 3679

FORMATION AND MORPHOLOGY OF ICE STALACTITES OBSERVED UNDER DEFORMING LEAD ICE.

Perovich, D.K., Richter-Menge, J.A., Morison, J.H., *Journal of glaciology*, 1995, 41(138), p.305-312, 17 refs.

50-452

SEA ICE, DENDRITIC ICE, ICE GROWTH, ICE RAFTING, ICE OPENINGS, ICE WATER INTERFACE, ICE BOTTOM SURFACE, ICE DEFORMATION, ICE CRYSTAL STRUCTURE, BRINES, BEAUFORT SEA

During the LeadEx main field experiment, held in Apr. 1992 in the Alaskan Beaufort Sea, a number of large ice stalactites were observed growing under young lead ice. Formation of the stalactites was associated with rafting of the thin, highly saline ice. The rafting caused the brine to drain rapidly from the ice at a temperature well below the freezing point of the surrounding water, which in turn caused ice to form in a hollow cylinder around the brine plume. Within a 15 h period after the rafting event, the stalactites, which were located approximately 10 m apart in a line along the up-wind edge of a 150 m wide lead, had grown to a length of 2 m. A detailed structural analysis of the upper part of one of these stalactites revealed that the interior channel, down which the brine flowed, was bounded by a zone of frazil ice that developed into a shell of columnar ice. The growth of the columnar ice was directed radially outward and the c axes of these crystals were oriented perpendicular to their growth direction.

MP 3680

FAN PRESSURIZATION MEASUREMENTS BY FOUR PROTOCOLS.

Flanders, S.N., AIVC Conference, 16th, Palm

Springs, CA, Sep. 19-22, 1995. Proceedings. Implementing the results of ventilation research. Vol.1, Coventry, England, University of Warwick, Air Infiltration and Ventilation Centre, 1995, p.165-174, 10 refs.

50-485

RESIDENTIAL BUILDINGS, HOUSES, VENTILATION, AIR LEAKAGE, AIR FLOW

Thirty-one independent fan pressurization measurement series were performed on seven apartments in three family housing buildings at Fort Riley, KS, using four protocols. The tests followed procedures in new or revised fan pressurization standards by the International Standards Organization (ISO), American Society for Testing and Materials (ASTM) and Canadian General Standards Board (CGSB). In addition, the effect of interzonal flow was considered. The three standards gave similar results. The tests during windy and calm conditions demonstrated that basic uncertainty calculations give a comparative indication of the quality of the results. The tests addressing interzonal flow did not show a strong influence on airtightness results, based on whether the adjacent units were open, closed, or pressurized to the same level.

MP 3681

SIMULATION OF SUMMER SNOWMELT ON THE GREENLAND ICE SHEET USING A ONE-DIMENSIONAL MODEL.

Rowe, C.M., Kuivinen, K.C., Jordan, R., *Journal of geophysical research*, Aug. 20, 1995, 100(D8), p.16,265-16,273, 52 refs.

50-585

ICE SHEETS, GLACIER MASS BALANCE, SNOWMELT, SNOW HYDROLOGY, ICE SHEETS, HEAT BALANCE, SNOW THERMAL PROPERTIES, GLACIAL METEOROLOGY, SNOW AIR INTERFACE, SNOW PHYSICS, PROFILES, MATHEMATICAL MODELS, SNOW COVER EFFECT, SIMULATION, GREENLAND

A one-dimensional heat and mass balance model of a snowpack over frozen soil was modified for use in glacial environments. The model solves a set of governing equations for the energy and mass balances of the snow, subject to observed meteorological conditions at the upper boundary and the assumption of a steady state at the lower boundary. The initial state of the snowpack is defined by the temperature, density and grain size profiles at the beginning of the simulation period. The data used to test the model on the Greenland ice sheet are a subset of the meteorological and surface data collected during the 1990 summer field season by the Swiss Federal Institute of Technology (ETH) Greenland Expedition. The site was located near the equilibrium line elevation on the west slope of the ice sheet. The relatively large amount of snowmelt experienced at this site during the summer of 1990 provides a robust test of the snowmelt model. Both the simulated height and mass of the snowpack agree well with the observations. The evolution of profiles of temperature, density and liquid water content also conform to the expectations of the physical changes taking place in the snowpack during melt.

MP 3682

PRECIPITATION PARAMETERS IN NATURAL OBSCURATION.

Hogan, A.W., Smoke/Obscurants Symposium, 14th, Laurel, MD, Apr. 17-19, 1990. Proceedings. Vol.2, Aberdeen Proving Ground, MD, U.S. Army Chemical Research, Development and Engineering Center (CRDEC), 1990, p.375-384, 34 refs.

50-734

FALLING SNOW, SNOWFALL, SNOWFLAKES, SNOW OPTICS, PRECIPITATION (METEOROLOGY), VISIBILITY, OPTICAL ABSORPTION, ATMOSPHERIC ATTENUATION, MILITARY OPERATION

Visibilities of less than 10 km are often accompanied by diminution of electro-optical transmission parameters that inhibit Army operations. Visibilities of this magnitude resulting from frozen precipitation pose additional difficulties as the precipitated ice alters target signatures and obscures ground-emplaced targets. Numerical parameters derived from snowfall and suspended ice crystal observations in the literature and the SNOW experiment database are presented. These numerical parameters allow generalized prediction of concentration of airborne snow or ice crystals, and the rate of obscuration of surfaces, from mass precipitation rate considerations. A comparison is presented, relating the concentration of airborne precipitation to aerosol concentrations.

MP 3683

SNOW SCAVENGING ON THE WINTER BATTLEFIELD.

Slota, J.R., Petzko, D.R., Cragin, J.H., Smoke/Obscurants Symposium, 14th, Laurel, MD, Apr. 17-19, 1990. Proceedings. Vol.2, Aberdeen Proving Ground, MD, U.S. Army Chemical Research, Development and Engineering Center (CRDEC), 1990, p.395-409, 9 refs.

50-735

FALLING SNOW, SNOW OPTICS, SCAVENGING, VISIBILITY

ITY, INFRARED RECONNAISSANCE, SMOKE GENERATORS, MILITARY OPERATION

The authors examined the effectiveness of inventory infrared (IR) self-screening obscuring in a winter battlefield environment. Snow scavenging mechanisms were incorporated into a standard U.S. Army battlefield obscuring model. Using this modified obscuring model as well as atmospheric transmission and EO system performance models, the authors analyze the threat posed by a postulated FLIR against a tracked vehicle deploying self-screening smoke in a ground-to-ground engagement.

MP 3684

PURPOSE AND ACHIEVEMENTS OF SMOKE WEEK XI.

Kennedy, B.W., Locke, B.A., Klimek, W., Perron, F.E., Jr., Smoke/Obscurants Symposium, 14th, Laurel, MD, Apr. 17-19, 1990. Proceedings. Vol.1, Aberdeen Proving Ground, MD, U.S. Army Chemical Research, Development and Engineering Center (CRDEC), 1990, p.217-231, 3 refs.

50-736

SNOW OPTICS, SNOW COVER EFFECT, VISIBILITY, LIDAR, SENSORS, PHOTOGRAPHIC RECONNAISSANCE, COLD WEATHER TESTS, MILITARY OPERATION
Smoke Week XI was conducted at the Defence Research Establishment Valcartier (DREV), Quebec, Canada, from Feb. 20 to Mar. 10, 1989. The test was designed to evaluate electro-optical sensor performance in atmospheres obscured by man-made obscuring agents as well as by snow. Forty-eight electro-optical sensors were involved in 50 trials for a total of 100 hours of test time. This paper explains the purpose and achievements of Smoke Week XI, including examples of data collected during this test.

MP 3685

MAPPING OF WINTER SURFACE CONDITIONS AT CAMP GRAYLING, MICHIGAN.

Haugen, R.K., Bates, R.E., Bruzewicz, A.J., Smoke/Obscurants Symposium, 16th, Laurel, MD, Apr. 14-16, 1992. Proceedings. Vol.1, Aberdeen Proving Ground, MD, U.S. Army Chemical Research, Development and Engineering Center (CRDEC), 1992, p.251-266, 9 refs.

50-738

SNOW SURVEYS, SNOW DEPTH, SNOW SURFACE TEMPERATURE, WEATHER FORECASTING, METEOROLOGICAL CHARTS, TERRAIN IDENTIFICATION, COMPUTERIZED SIMULATION, MAPPING, UNITED STATES—MICHIGAN

The goal of this project was to produce a map showing snow cover and surface temperature conditions in support of a winter Joint Munitions Test and Evaluation Program Office (CHICKEN LITTLE, JPO) test during Feb.-Mar. 1990. The approach was to use the GRASS (Geographical Resources Analysis Support System) Geographical Information System (GIS) to estimate snow-cover depth and snow surface temperature background characteristics for the Camp Grayling, MI Winter Field Test Site, an area of approximately 6 km². Based on digitized topographic and vegetation maps, a set of six surface background maps was developed. The interpreted scenes for two days during Feb. 1990 were chosen to provide maximum background surface condition differences. Input data included an array of temperature and snow measurements from the Environmental Plot within the test site and supplementary climatic data from the NOAA station at Grayling and the Houghton Lake, Michigan FAA station. Solar azimuths and angle of incidence were calculated. The rules for the GIS input were based both on observational data from the above source and the best estimate based on experience for parameters such as temperature difference based on lapse rates, slope, and aspect. Snow-cover depth calculations were based on measured deposition at several sites, time of day, elevation, and type of vegetation.

MP 3686

THERMAL STRESS MEASUREMENTS IN ASPHALT CONCRETE.

Janoo, V.C., Bayer, J., Jr., Walsh, M.R., U.S. Department of Transportation. Federal Aviation Administration. Report, July 1993, DOT/FAA/RD/92/13, 30p., Refs. p.29-30. For another source see 48-720.

50-760

BITUMINOUS CONCRETES, CRACKING (FRACTURING), THERMAL STRESSES, PAVEMENTS, COLD WEATHER PERFORMANCE, COLD STRESS, TENSILE PROPERTIES, MEASUREMENT

Asphalt concrete (AC) pavements in cold regions are prone to thermal cracking. There are two theories to explain this. The first one is that at some low temperature, the thermal stress in the pavement structure exceeds the tensile strength of the mixture, usually in the winter. The second is that the AC mixture fails through thermal fatigue caused by daily temperature cycling. There are many ways of characterizing AC performance at low temperatures, and this report summarizes the different failure criteria and test methods for doing this. One test method described here that CRREL has developed is a thermal stress test device for measuring thermally induced stresses in the laboratory. The device can be used for monotonic and cyclic loading, while various temperature drop rates can be applied to the specimen. The

calibration of the test apparatus, loading pattern and specimen configuration used are described and typical results are presented.

MP 3687

TESTING OF RADOME MATERIAL AND SPECIAL COATINGS FOR NORTH WARNING SYSTEM.

Crory, F.E., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Mar. 1988, 23p. + appends., 2 refs.

50-761

RADOMES, PROTECTIVE COATINGS, WARNING SYSTEMS, COUNTERMEASURES, COLD WEATHER TESTS, ICING, SNOW COVER, DROPS (LIQUIDS)

MP 3688

SUBMESOSCALE VARIATION IN SNOW-INDUCED OBSCURATION.

Hogan, A.W., Smoke/Obscurants Symposium, 15th, Laurel, MD, Apr. 16-18, 1991. Proceedings. Vol.2, Aberdeen Proving Ground, MD, U.S. Army Chemical Research, Development and Engineering Center (CRDEC), 1991, p.521-529, 16 refs.

50-762

FALLING SNOW, SNOWFLAKES, SNOW OPTICS, VISIBILITY, COMPUTER PROGRAMS, MILITARY OPERATION

MP 3689

SNOWFALL INTENSITY CLIMATOLOGIES WITHIN THE CONTIGUOUS UNITED STATES.

Ryerson, C.C., Smoke/Obscurants Symposium, 15th, Laurel, MD, Apr. 16-18, 1991. Proceedings. Vol.2, Aberdeen Proving Ground, MD, U.S. Army Chemical Research, Development and Engineering Center (CRDEC), 1991, p.531-540, 21 refs.

50-763

FALLING SNOW, SNOWFALL, SNOWSTORMS, SNOW OPTICS, VISIBILITY, METEOROLOGICAL CHARTS, UNITED STATES

The suspended cross-sectional area of snow is a natural property of the obscuring frequently responsible for disruption of battlefield electro-optical target acquisition systems. This cross-sectional area is not uniquely related to the mass or depth accumulation rates of snow described as snowfall intensity, but is derivable from them. Hourly snowfall intensity was compiled for the lower 48 states (CONUS) from four years of National Weather Service hourly liquid precipitation measurements and hourly present weather codes. Hourly snowfall intensity was mapped for 148 weather stations. High intensity snowfalls, approaching about 1 mm/hour water equivalent, generally occur in mountainous areas and along the Northeast Coast, with lower intensities, approaching 0.6 mm/hour, occurring in the northern Plains. Despite their reported violence, the Great Lakes lake-effect areas showed intensities one-half of a standard deviation below the CONUS mean. Methodological and climatological reasons for the patterns and for mapping tactically sensitive areas are addressed.

MP 3690

SNOW SCAVENGING EFFECTS ON LARGE-AREA SMOKE SCREENS.

Slota, J.R., Cragin, J.H., Smoke/Obscurants Symposium, 15th, Laurel, MD, Apr. 16-18, 1991. Proceedings. Vol.2, Aberdeen Proving Ground, MD, U.S. Army Chemical Research, Development and Engineering Center (CRDEC), 1991, p.541-559, 10 refs.

50-764

FALLING SNOW, SNOW OPTICS, SCAVENGING, SMOKE GENERATORS, VISIBILITY, INFRARED RECONNAISSANCE, COMPUTERIZED SIMULATION, MILITARY OPERATION

The authors examine the effectiveness of brass flake infrared (IR) battlefield obscuring during snowfall. Previous laboratory measurements made at CRREL have shown that scavenging of smoke particles by falling snow reduces the effectiveness of a smoke cloud. Offsetting this increase in transmission through the smoke is a reduction in transmission due to the snow itself. To illustrate the overall effect of these two mechanisms on the battlefield, the US Army COMBIC battlefield obscuring model is used with slight modifications. In conjunction with this obscuring model, a US Army standard atmospheric transmission model and an EO system performance model are coupled to predict target detection ranges for a postulated threat FLIR against a tracked vehicle in a ground-to-ground engagement. The model is exercised for varying snowfall intensities and crystal types and for various numbers of smoke generator sources. An analysis of these scenarios is presented, with suggested criteria for when scavenging of smoke by snow is important.

MP 3691

BACKGROUND CLASSIFICATION FOR INFRARED SEEKERS.

Berger, R.H., Smoke/Obscurants Symposium, 15th, Laurel, MD, Apr. 16-18, 1991. Proceedings. Vol.2,

Aberdeen Proving Ground, MD, U.S. Army Chemical Research, Development and Engineering Center (CRDEC), 1991, p.837-843, 3 refs.

50-765

INFRARED RECONNAISSANCE, TERRAIN IDENTIFICATION, SNOW COVER EFFECT, IMAGE PROCESSING, COMPUTER PROGRAMS, MILITARY OPERATION

The detection of a target embedded in a scene depends upon the target/background contrast, target shape, size and other more subtle characteristics such as relative motion. The one discrimination characteristic common to all detection schemes is the reliance on contrast. The other cues may be used, but they are only made apparent when there is sufficient contrast. How effective a seeker is in detecting a target also depends upon the contrast between various scene elements in the background, since these contrasts are the source of false alarms that reduce the overall effectiveness of the seeker. To provide a measure of generic seeker effectiveness against various backgrounds, the backgrounds were classified by the inherent contrast within them. This was done by examining the various scene elements within the background and determining what weather and environmental conditions have a critical role in determining the contrast of these scene elements. Data from the Chicken Little II winter tests in Grayling, MI were used to develop the classification methodology.

MP 3692

EVALUATION OF METHANOL AND NAHSO₄ FOR PRESERVATION OF VOLATILE ORGANIC COMPOUNDS IN SOIL SUBSAMPLING.

Hewitt, A.D., American environmental laboratory, Aug. 1995, 7(8), p.16-21, 24 refs.

50-780

SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, CHEMICAL ANALYSIS

MP 3693

BIOREMEDIATION OF A PETROLEUM-CONTAMINATED CRYIC SOIL: EFFECTS OF PHOSPHORUS, NITROGEN, AND TEMPERATURE.

Walworth, J.L., Reynolds, C.M., Journal of soil contamination, 1995, 4(3), p.299-310, 20 refs.

50-781

OIL SPILLS, SOIL POLLUTION, CRYOGENIC SOILS, SOIL MICROBIOLOGY, SOIL CHEMISTRY, LAND RECLAMATION, ENVIRONMENTAL PROTECTION, WASTE DISPOSAL

Bioremediation has proved an effective means of treating petroleum-contaminated soils in cold areas, although the conditions required to maximize bioremediation in cold region (cryic) soils are not well documented. A laboratory study was conducted to investigate the effects of nitrogen and phosphorus levels and temperature on petroleum bioremediation. A cryic entisol contaminated with diesel fuel was treated with nitrogen (0, 400, 800, or 1200 mg/kg of soil) and phosphorus (0, 60, 120, or 180 mg/kg of soil) and incubated at two temperatures (10 and 20°C). At 10°C, bioremediation rates were not affected by fertility treatments. At 20°C, reaction rates were increased by the addition of P, but unaffected by N. Regardless of fertility regime, the rate of diesel loss was much greater in soil incubated at 20°C than in soil incubated at 10°C.

MP 3694

PHYSICAL MODELLING.

Wuebben, J.L., River ice jams. Edited by S. Beltaos, Highlands Ranch, CO, Water Resources Publications, LLC, 1995, p.173-204.

50-789

RIVER ICE, ICE JAMS, ICE WATER INTERFACE, RIVER FLOW, ICE FORECASTING, ICE MODELS, ENVIRONMENTAL SIMULATION, ENVIRONMENTAL TESTS, MATHEMATICAL MODELS

MP 3695

FIELD OBSERVATIONS AND MEASUREMENTS.

Petryk, S., Gatto, L.W., Prowse, T.D., Demuth, M., Wuebben, J.L., Beltaos, S., River ice jams. Edited by S. Beltaos, Highlands Ranch, CO, Water Resources Publications, LLC, 1995, p.253-286.

50-791

RIVER ICE, ICE JAMS, ICE SURVEYS, ICE CONDITIONS, ICE WATER INTERFACE, RIVER FLOW, ICE FORECASTING

MP 3696

STUDY OF MULTI-YEAR PRESSURE RIDGES AND SHORE ICE PILE-UP.

Kovacs, A., APOA Project 89, Calgary, Alberta, Arctic Petroleum Operators Association, Oct. 1975,

45p., 16 refs. For another version see 34-774.
50-855

FAST ICE, ICE SCORING, ICE PILEUP, PRESSURE RIDGES, ICE COVER THICKNESS, BEAUFORT SEA

MP 3697

SHORE ICE PILE-UP AND RIDE-UP: FIELD OBSERVATIONS, MODELS, THEORETICAL ANALYSES.

Kovacs, A., Sodhi, D.S., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, 1979, 84p., Refs. p.76-84. For another version see 34-3631.

50-856

FAST ICE, ICE PUSH, ICE PILEUP, ICE OVERRIDE, ICE LOADS, ICE PRESSURE, ICE FRICTION

A review of the literature on shore ice pile-up and ride-up in arctic and subarctic waters is presented, along with an account of recent observations made by the authors. Cross-sectional profiles of these features are presented from which models and theoretical analyses were made. The expressions derived give the force required to overcome gravitational potential and friction occurring during ice-piling and ride-up. It was found that the total force required during ice-piling or ride-up was of the order of 10 to 350 kPa (about 1.5 to 50 psi). Field observations revealed that shore ice pile-up or ride-up appears to occur within a period of less than 30 minutes, at any time of year but most often in the spring and fall. Pile-up seldom occurs more than 10 m inland from the sea but ride-up frequently extends 50 m or more inland, regardless of ice thickness. While steeply sloping shores do not favor ice ride-up, sea ice has mounted the steep, 9-m high bluff at Barrow, AK, destroying structures and taking lives.

MP 3698

ENVIRONMENTALLY CAUSED VARIATION IN EXTERIOR INTRUSION DETECTION.

Peck, L., European Convention on Security and Detection, Brighton, England, May 16-18, 1955, London, Institution of Electrical Engineers, 1955, p.167-171, 2 refs.

50-888

WARNING SYSTEMS, INFRARED RECONNAISSANCE, DETECTION, SENSORS, SNOW OPTICS, SNOW COVER EFFECT

MP 3699

RIVER ICE MOTION DETECTOR.

Zufelt, J.E., Clark, C.H., Deck, D.S., U.S. Patent Office. Patent, Aug. 29, 1995, 6 col., USP-5,446,448, 7 refs.

50-889

RIVER ICE, ICE BREAKUP, ICE JAMS, ICE DETECTION, ICE REPORTING, ICE FORECASTING, FLOOD FORECASTING, WARNING SYSTEMS, DATA TRANSMISSION
A river ice motion detector system for detecting ice run conditions in order to warn communities downstream that flooding from ice jams is possible, comprises a voltage source, a multi-meter, a detector unit and a plurality of sensor loops, all having communication with each other. The voltage source provides an input signal to the detector unit and then to the sensor loops. The sensor loops provides a second signal back to the multi-meter in response to the input signal. The detector unit has a plurality of resistors and a plurality of switches, the values of the resistors determined providing large step differences, allowing the detector unit to determine which of the sensor loops is broken indicating a possible ice run. The switches are normally closed, providing a test for the system when the switches are deliberately opened.

MP 3700

HOLDING-TIME ESTIMATES FOR SOILS CONTAINING EXPLOSIVES RESIDUES: COMPARISON OF FORTIFICATION VS. FIELD CONTAMINATION.

Grant, C.L., Jenkins, T.F., Myers, K.F., McCormick, E.F., *Environmental toxicology and chemistry*, 1995, 14(11), p.1865-1874, 32 refs.

50-944

SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, CHEMICAL ANALYSIS, EXPLOSIVES

Maximum acceptable preextraction analytical holding times (MHTs) were estimated by spiking aqueous solutions of two nitramines, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) and three nitroaromatics, 1,3,5-trinitrobenzene (TNB), 2,4,6-trinitrotoluene (TNT), and 2,4-dinitrotoluene (2,4-DNT), into three soils. Nitramines were stable over an 8-week test period at all storage temperatures, but nitroaromatics, which were reasonably stable when frozen, degraded rapidly at room temperature and more slowly under refrigeration. In contrast, both nitroaromatics and nitramines were quite stable under refrigeration for four field-contaminated soils. When three of these field-contaminated soils were subsequently fortified with TNT and TNB, rapid degradation under refrigeration was again observed for the added nitroaromatics. The rates of degradation were quite different in

the three soils, further emphasizing the uncertainties in MHT estimates derived from fortified soils. The authors conclude that fortified soils can produce very different estimates of MHTs, recoveries, treatability, etc., compared to field-contaminated soils even when spiking is done in aqueous media.

MP 3701

ADVECTIVE-DIFFUSIVE HEAT TRANSFER IN SNOW.

Albert, M.R., New York, American Society of Mechanical Engineers, 1995, 4p., Presented at the ASME International Mechanical Engineering Congress and Exposition, San Francisco, Nov. 12-17, 1995. 7 refs.

50-945

SNOW THERMAL PROPERTIES, SNOW HEAT FLUX, SNOW PERMEABILITY, SNOW AIR INTERFACE, AIR FLOW, ADVECTION, CONVECTION, THERMAL DIFFUSION, HEAT TRANSFER

In controlled laboratory settings it is possible to identify, isolate, and explain various heat transfer phenomena. In field experiments associated with natural phenomena, however, it is often difficult to isolate the effects from other confounding natural events. Such is the case with the movement of air through a natural snowpack. In the literature there have been reports of snow and fin temperature measurements that cannot be predicted by heat conduction models. Advective heat transfer due to air flow within the snow is indicated, and the existence of ventilation (windpumping) is currently being debated in the literature. One step toward the goal of identifying natural advective effects involves observing effects that are induced in the snow cover when a known forcing for the air flow is applied. In addition, a model that is able to reproduce measured, controlled forced convection will provide a good foundation for modeling natural ventilation. In this paper a numerical model is employed to examine advective-diffusive (Peclet number) effects on multi-dimensional ventilation of a naturally occurring snowpack. The model is verified by comparing calculated results with a field experiment where air was forced through a natural snowpack. It is found that air flow through the pack was sufficient to produce advection-dominated heat transfer throughout most of the pack.

MP 3702

LARGE-SCALE LANDSLIDE SIMULATIONS: GLOBAL DEFORMATION, VELOCITIES AND BASAL FRICTION.

Campbell, C.S., Cleary, P.W., Hopkins, M.A., *Journal of geophysical research*, May 10, 1995, 100(B5), p.8267-8283, 34 refs.

50-946

LANDSLIDES, AVALANCHE MECHANICS, AVALANCHE TRACKS, AVALANCHE MODELING

The cause of the apparent small friction exhibited by long runout landslides has long been speculated upon. In an attempt to provide some insight into the matter, this paper describes results obtained from a discrete particle computer simulation of landslides composed of up to 1,000,000 two-dimensional discs. While simplified, the results show many of the characteristics of field data (the volumetric effect on runout, preserved strata, etc.) and with allowances made for the two-dimensional nature of the simulation, the runouts compare well with those of actual landslides. The results challenge the current view that landslides travel as a nearly solid block riding atop a low friction basal layer. Instead, they show that the mass is completely shearing and indicate that the apparent friction coefficient is an increasing function of shear rate. The volumetric effect can then be understood. With all other conditions being equal, different size slides appear to travel with nearly the same average velocity; however, as the larger landslides are thicker, they experience smaller shear rates and correspondingly smaller frictional resistance.

MP 3703

TWO-DIMENSIONAL DYNAMIC SIMULATION OF SOLID FRACTURE. PART I: DESCRIPTION OF THE MODEL.

Potapov, A.V., Hopkins, M.A., Campbell, C.S., *International journal of modern physics C*, 1995, 6(3), p.371-398, 18 refs.

50-947

FRACTURING, CRACK PROPAGATION, ELASTIC PROPERTIES, PLASTIC DEFORMATION, COMPUTERIZED SIMULATION, MATHEMATICAL MODELS

This paper describes a two-dimensional computer simulation of solid fracture that allows the body and the fragments to be followed well beyond the point of simple crack formation. The model is based on discrete particle computer simulations used for studying granular flows. Here, macroscopic polygonal solids are constructed by "gluing" together small elements. Depending on the stress conditions, the glued bonds between the elements can respond elastically, undergo plastic failure or break, allowing cracks to propagate across the macroscopic particle along the boundaries between their microscopic constituents. In essence, this process creates a simulated material upon which breakage occurs. Several element shapes have been studied.

MP 3704

UNSURFACED ROAD MAINTENANCE MANAGEMENT.

Eaton, R.E., Beacham, R.E., Technical manual TM 5-626, Washington, D.C., U.S. Department of the Army, Jan. 1995, Var. p., 16 refs. For another version see 47-2756.

50-952

ROAD MAINTENANCE, EARTHWORK, MILITARY FACILITIES, MANUALS

MP 3705

DETERMINATION OF VOLUME AND SURFACE SCATTERING FROM SALINE ICE USING ICE SHEETS WITH PRECISELY CONTROLLED ROUGHNESS PARAMETERS.

Bredow, J.W., et al, *IEEE transactions on geoscience and remote sensing*, Sep. 1995, 33(5), p.1214-1221, 5 refs.

50-982

SEA ICE, REMOTE SENSING, YOUNG ICE, SURFACE ROUGHNESS, ALBEDO, WAVE PROPAGATION, BACK-SCATTERING, RADAR ECHOES, TOPOGRAPHIC EFFECTS, SIMULATION

Experiments were performed at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) to precisely determine the relative contributions of surface and volume scattering from saline ice that has well-known surface roughness characteristics. The ice growth phase of the experiment made use of two 6-ft diameter tanks and a 6-ft diameter mold with known roughness statistical parameters of rms height=0.25 cm and Gaussian correlation (correlation length=2.0 cm). One tank was used for growing a moderately thick saline ice sheet with very smooth surface, and the other was used for growing a thin layer of freshwater ice over the surface. The latter resulted in a layer with one statistically known rough boundary and one smooth boundary. Wide-bandwidth, multiple incidence angle backscattering measurements were performed, first on the bare saline ice sheet and then on the same sheet after the thin freshwater ice sheet was placed on top of it. Results indicate that the surface scattering dominates over saline ice volume scattering at all frequencies for low incidence angles for both the very smooth and Gaussian rough surfaces. The significance of volume scattering depends strongly on angle of incidence, frequency, volume scattering albedo, surface roughness, and surface correlation function. (Auth.)

MP 3706

ANALYTICAL METHODS FOR CHARACTERIZATION OF EXPLOSIVES-CONTAMINATED SITES ON U.S. ARMY INSTALLATIONS.

Jenkins, T.F., Walsh, M.E., Thorne, P.G., *SPIE—The International Society for Optical Engineering. Proceedings*, 1995, Vol.2504, Environmental Monitoring and Hazardous Waste Site Remediation, Munich, Germany, June 19-21, 1995, p.342-349, 40 refs.

50-1094

SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, EXPLOSIVES, MILITARY FACILITIES

The U.S. Army manufactures munitions at facilities throughout the United States. Many of these facilities are contaminated with residues of explosives from production and disposal of off-specification and out-of-date munitions. The first step in remediating these sites is careful characterization. Currently sites are being characterized using a combination of on-site field screening and off-site laboratory analysis. Most of the contamination is associated with TNT (2,4,6-trinitrotoluene) and RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) and their manufacturing impurities and environmental transformation products. Both colorimetric and enzyme immunoassay-based field screening methods have been used successfully for on-site characterization. These methods have similar detection capabilities but differ in their selectivity. Although field screening is very cost-effective, laboratory analysis is still required to fully characterize a site. Laboratory analysis for explosives residues in the United States is generally conducted using high-performance liquid chromatography equipped with a UV detector. Air-dried soils are extracted with acetonitrile in an ultrasonic bath. Water is analyzed directly if detection limits in the range of 10-20 µg/L are acceptable, or pre-concentrated using either salting-out solvent extraction with acetonitrile or solid phase extraction.

MP 3707

DEVELOPMENT OF COLORIMETRIC FIELD SCREENING METHODS FOR MUNITIONS COMPOUNDS IN SOIL.

Jenkins, T.F., Walsh, M.E., Schumacher, P.W., Thorne, P.G., *SPIE—The International Society for Optical Engineering. Proceedings*, 1995, Vol.2504, Environmental Monitoring and Hazardous Waste Site Remediation, Munich, Germany, June 19-21, 1995, p.324-333, 27 refs.

50-1095

SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, EXPLOSIVES, MILITARY FACILITIES

Simple colorimetric tests have been developed to screen for the presence of TNT, TNB, DNT, DNB, tetryl, RDX, HMX, nitroglycerine (NG), PETN, nitrocellulose (NC), nitroguanidine (NQ), picric acid and ammonium picrate in soil. Soils are extracted by manual shaking with acetone. For the nitroaromatics, the extracts are reacted with potassium hydroxide and sodium sulfite to form their colored Janzky complexes. For RDX, HMX, NG, PETN, NC and NQ, extracts are passed through an anion exchange resin to remove nitrate, and then acidified with acetic acid; the nitramines and nitrate esters are reduced with zinc to form nitrous acid. The nitrous acid is detected by the Griess reaction using a Hach Nitriver 3 powder pillow, which produces a highly colored azo dye. Detection of these analytes can be obtained visually and concentrations estimated from absorbance measurements at 540 nm for TNT, TNB and tetryl, 570 nm for DNTs and DNB, and at 510 nm for RDX, HMX, NG, PETN, NC and NQ. For picric acid/ammonium picrate, the acetone extract is passed through a basic ion-exchange column that retains picrate ion. The column is rinsed with methanol to elute interferences, and the picrate is desorbed with acetone containing several drops of sulfuric acid. The extract is diluted with deionized water, and the concentration of picrate is obtained from the absorbance at 400 nm. Detection limits are about 1 µg/g for all analytes except NG, NC and NQ, which are slightly higher.

MP 3708 USE OF GEOSYNTHETIC CAPILLARY BARRIERS TO REDUCE MOISTURE MIGRATION IN SOILS.

Henry, K.S., *Geosynthetics international*, 1995, 2(5), p.883-888, 10 refs.

50-1096

SOIL WATER MIGRATION, CAPILLARITY, GEOTEXTILES, VAPOR BARRIERS, SOIL STABILIZATION
Capillary theory is reviewed and applied to the use of capillary barriers in soils. Specific emphasis is placed on the use of geosynthetics as capillary barriers. Theory and experimental evidence indicate that capillary barriers placed horizontally in soils above the water table significantly reduce the rate of water flow across them in response to hydraulic gradients. As a result, they are very effective in keeping soil from becoming saturated with water due to capillary action.

MP 3709 TWO-DIMENSIONAL DYNAMIC SIMULATION OF SOLID FRACTURE. PART II: EXAMPLES.

Potapov, A.V., Campbell, C.S., Hopkins, M.A., *International journal of modern physics C*, 1995, 6(3), p.399-425, 10 refs.

50-1097

FRACTURING, CRACK PROPAGATION, COMPRESSIVE PROPERTIES, IMPACT STRENGTH, SHEAR STRENGTH, COMPUTERIZED SIMULATION
This paper uses a model to simulate fracture in many simple systems with the goal of evaluating the advantages and deficiencies of the model. The examples include compressive failure of a rectangular sample, four-point shear failure of a beam and the impact of particles with a plate and binary impacts of particles. Where possible, the simulated results seem to be in good agreement with typical experimental results. Finally, a simulation of ball-milling, which involves the flow and fracture of many particles, is shown to demonstrate the overall utility of the model.

MP 3710 INDUSTRY GETS AN EDGE FROM THE CORPS.

Chalmers, P., *Engineer update*, Nov. 1995, 19(11), p.12.

50-1099

ECONOMIC DEVELOPMENT, RESEARCH PROJECTS, ICE CONTROL, WINTER CONCRETING, COMPOSITE MATERIALS, REINFORCED CONCRETES
Private companies win contracts after subcontracting to CRREL (U.S. Army Cold Regions Research and Engineering Laboratory) for winter concreting, Niagara river ice control, and composite plastic grid-reinforced concretes.

MP 3711 CASE STUDY OF INSULATED PAVEMENT IN JACKMAN, MAINE.

Kestler, M.A., Berg, R.L., *Transportation research record*, 1995, No.1481, p.47-55, 10 refs.

50-1155

RUNWAYS, PAVEMENTS, SUBGRADE SOILS, FROST PENETRATION, FROST RESISTANCE, FROST PROTECTION, THERMAL INSULATION, SUBGRADE MAINTENANCE, UNITED STATES—MAINE
Traditionally, detrimental effects of frost action are reduced by thick fills or by excavation and removal of large quantities of frost-susceptible material and replacement with a thick layer of non-frost-susceptible material. However, incorporating an insulating layer within the pavement structure can often provide a cost-effective alternative for protecting the subgrade from frost penetration. In 1986 the runway, taxiway, and parking apron at Newton Field, a small airport in Jackman, ME, were reconstructed using a layer of extruded polystyrene insulation 51 mm (2 in.) thick as part of the pavement structure. Because test results

from the first winter of observation showed substantial frost penetration beneath the runway insulation, four additional test sections of various combinations of insulation and sand subbase thickness were constructed adjacent to the parking apron in 1987. The insulated test sections, which were constructed under tighter controls on a firm working platform and in a slightly drier location than the runway, experienced very little frost penetration into the subgrade. The good performance of the insulated test sections as well as runway observations, methods used to investigate insulation integrity, and theories considered to explain the relatively poor performance of some sections of the insulated runway pavement are discussed.

MP 3712 ANTARCTIC AIRFIELDS.

Mellor, M., *American Geophysical Union. Antarctic research series*, 1995, 67(4), Contributions to antarctic research IV, p.143-151, 7 refs.

50-1192

AIRCRAFT LANDING AREAS, RUNWAYS, ICE RUNWAYS, AIRPORTS, AIRCRAFT OPERATIONS

Following a summary of recent U.S. air activities in Antarctica, aircraft runways are considered. Various airfield options from open-field landings to conventional paved runways are dealt with, the relevant factors being given in tables that cover (1) construction and maintenance and (2) operations. Bearing capacity, rutting resistance, surface roughness and runway dimensions are discussed. It is concluded that a system of hard-surface runways for conventional aircraft is technically feasible. (Auth.)

MP 3713 COMPACTED SNOW RUNWAY TECHNOLOGY ON THE ROSS ICE SHELF NEAR MCMURDO, ANTARCTICA.

Blaisdell, G.L., Klokov, V., Diemand, D., *American Geophysical Union. Antarctic research series*, 1995, 67(4), Contributions to antarctic research IV, p.153-173, 14 refs.

50-1193

AIRCRAFT LANDING AREAS, SNOW COMPACTION, ICE RUNWAYS, SNOW (CONSTRUCTION MATERIAL), ANTARCTICA—MCMURDO STATION, ANTARCTICA—ROSS ICE SHELF

The United States Antarctic Program currently operates wheeled aircraft from an annual sea-ice runway at McMurdo until about Dec. 15 each year. After that time it is limited to use of a snow runway and specialized ski-wheel aircraft. On the Ross Ice Shelf near McMurdo, runway technology is being developed to support conventional heavy wheeled aircraft. The runway capitalizes on the natural characteristics of the location and uses only snow and ice as construction materials. The runway is located inside the transition zone between the accumulation and ablation regions on the ice shelf. The first runway developed uses a thin, permanent cap of snow over natural blue ice to level undulations in the underlying surface and to protect the ice from intense solar radiation during the peak of summer (to prevent subsurface melt-pool formation). The snow cap was produced by compaction with a heavy roller during the warmest part of the year; the snow was then left to sinter and strengthen with falling temperatures. In early Feb., the runway was able to support wheeled operation of a fully loaded LC-130 Hercules. (Auth.)

MP 3714 GLACIOLOGY OF THE MCMURDO ICE SHELF IN THE AREA OF AIR OPERATIONS.

Klokov, V., Diemand, D., *American Geophysical Union. Antarctic research series*, 1995, 67(4), Contributions to antarctic research IV, p.175-195, 12 refs.

50-1194

GLACIOLOGY, ICE SHELVES, ICE FORMATION, ICE ACCRETION, ANTARCTICA—MCMURDO ICE SHELF

Two experimental runways have been built on the McMurdo Ice Shelf at the Pegasus site, about 13 km south of McMurdo Station. One of these runways was constructed using compacted snow technology while the other has a temporarily exposed blue ice surface. Conditions here are such that the annual snowfall can be removed entirely, baring the blue ice of the shelf, or compacted in place to preserve its reflective protective cover and to provide a strong surface capable of supporting wheeled aircraft traffic. During the 1991-92 and 1992-93 austral summers, detailed glaciological studies were conducted on the McMurdo Ice Shelf to identify snow accumulation, stratigraphy and the summer melt behavior. On the basis of the data collected, a runway location midway between the Pegasus site and Williams field appears to be an excellent site for construction of a permanent compacted snow runway on a deep snow foundation. This runway would be similar to the one used by wheeled aircraft at Russia's Molodezhnaya Station. Such a runway in the McMurdo area, in conjunction with a blue ice runway at the Pegasus site, would provide for wheeled aircraft access throughout the austral summer. This would eliminate the need for annual construction of the sea ice runway and for continued maintenance of Williams Field. (Auth. mod.)

MP 3715 DELIVERY OF FUEL AND CONSTRUCTION MATERIALS TO AMUNDSEN-SCOTT SOUTH POLE STATION.

DenHartog, S.L., Blaisdell, G.L., *American Geophysical Union. Antarctic research series*, 1995, 67(4), Contributions to antarctic research IV, p.197-216, 14 refs. For another source see 48-1001 or 21G-49291.

50-1195

CONSTRUCTION MATERIALS, LOGISTICS, MATERIALS, RUNWAYS, MOTOR VEHICLES, COST ANALYSIS, ANTARCTICA—AMUNDSEN-SCOTT STATION

Plans are underway to rebuild Amundsen-Scott Station while maintaining the current science and operational program. The new station will require the delivery of large amounts of construction materials. None of the existing delivery systems is expected to be capable, within a reasonable time period, of supporting both current operations and the transport needs for construction of a new station. The authors have analyzed several options for moving construction materials and fuel to South Pole station. Each option assumes that goods will be transported to the antarctic continent by ship. The options include (1) construction of a snow runway at the South Pole capable of supporting wheeled aircraft, (2) development of an inland blue ice runway that is capable of supporting heavy wheeled aircraft coupled with an over-snow haulage system to the pole, (3) over-snow vehicle haulage from McMurdo to the pole, and (4) vehicle haulage from a coastal station. The results of this study are probably best used as a starting point for any serious planning and budgeting for the development of a new South Pole station. (Auth. mod.)

MP 3716 TRIAXIAL COMPRESSIVE STRENGTH OF FROZEN SOIL UNDER CONSTANT DEFORMATION RATES.

Zhu, Y.L., Carbee, D.L., Quanguo dongtu xueshu huiyi taolunwen xuanji (Chinese National Conference on Permafrost, 3rd, Harbin, China, Aug. 19-24, 1986. Proceedings), Beijing, Kexue chubanshe (Science Press), 1989, p.179-187, In Chinese. 8 refs. For an English version see 42-4204.

50-1368

SOIL FREEZING, FROZEN GROUND STRENGTH, FROZEN GROUND COMPRESSION, SOIL CREEP, SOIL TESTS

MP 3717 GEOMETRY OF HEAT AND MASS TRANSFER IN DRY SNOW: A REVIEW OF THEORY AND EXPERIMENT.

Arons, E.M., Colbeck, S.C., *Reviews of geophysics*, Nov. 1995, 33(4), p.463-493, Refs. p.490-493.

50-1401

SNOW PHYSICS, PHYSICAL PROPERTIES, MICROSTRUCTURE, POROSITY, METAMORPHISM (SNOW), CLASSIFICATIONS, TERMINOLOGY, HEAT TRANSFER COEFFICIENT, MASS TRANSFER, SNOW THERMAL PROPERTIES

A century ago, Maxwell and Rayleigh each modeled the physical properties of aggregate materials as discrete spheres embedded in continuous matrices. Although the particles of interest in snow are not spheres and do have interconnections, these basic models give first-order predictions of the thermal conductivity. In the last 3 decades, scientists have attempted to make the predictions more precise by determining the effect of geometry on heat and mass flow using basic physical models and data collected from images of planar sections of aggregates. Under favorable circumstances, physical parameters and quantitative microscopic parameters of an aggregate may be highly correlated, but physical understandings of the geometric effects are not likely to arise from such studies until physical models can be based on measurable fundamental parameters. In snow, as in other aggregates, that goal seems remote.

MP 3718 DYNAMIC TESTING OF FROZEN SOIL SAMPLES WITH AN EXPLODING WIRE SYSTEM.

Fyfe, I.M., MSNW report No.68-53-1, Seattle, Mathematical Sciences Northwest, Inc., Mar. 1968, 37p., 4 refs. Sponsored by U.S. Army Cold Regions Research and Engineering Laboratory under Contract No.DA27-021-AMC-56(X).

50-1668

FROZEN GROUND STRENGTH, FROZEN GROUND COMPRESSION, SOIL TESTS, STRAIN TESTS, EXPLOSION EFFECTS, SHOCK WAVES

The possibilities inherent in an exploding wire system to act as a stress wave loading device for frozen soil samples are investigated. Primary consideration is given to using the system to obtain experimental data required in the determination of the dynamic properties of frozen soils of varying degrees of water saturation. The problems of sample configuration, measuring techniques, and loading ranges are discussed. The stress-density behavior behind a shock front was obtained for soil samples at stress levels varying in intensity from a few hundred pounds per square inch to as high as 12 kbars. The stress-density relation is

obtained by measuring two of the four unknown variables associated with the application of the conservation of mass and momentum across the shock front. The frozen soil samples investigated were supplied by USA CRREL and are identified as follows: 100 and 50% saturated Suffield silty clay, an undisturbed set of specimens of the same material, and a few samples of 100% saturated West Lebanon (New Hampshire) glacial till. All materials were tested at -10°C.

MP 3719

ADSORPTION-DESORPTION OF 2,4,6-TRINITROTOLUENE AND HEXAHYDROL-1,3,5-TRINITRO-1,3,5-TRIAZINE IN SOILS.

Xue, S.K., Iskandar, I.K., Selim, H.M., *Soil science*, Nov. 1995, 100(5), p.317-327, 15 refs. 50-1686

SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, EXPLOSIVES, MILITARY FACILITIES

The adsorption-desorption behavior of TNT (2,4,6-trinitrotoluene) and RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) in bentonite/sand and Norwood and Kolin soils was studied. The kinetics of TNT and RDX retention were measured using batch methods for a range of input concentrations. For RDX, the adsorption isotherms were distinctly linear. The TNT adsorption isotherm for bentonite/sand mixture appeared linear and was described equally well using linear, Freundlich, Langmuir, and a modified Langmuir model. For the Norwood and Kolin soils, TNT adsorption isotherms exhibited distinct nonlinearity and the Freundlich model provided the best fit. As indicated by the K_d values, TNT exhibited stronger retention or affinity to all soils and the bentonite/sand mixture than for RDX. The RDX retention data indicated little time-dependent behavior. The TNT retention data indicated a continued decrease in TNT concentration with time in the Norwood and Kolin soils. This was possibly caused by the formation and subsequent adsorption of transformation products because transformation products, such as amino nitro toluene compounds, were identified during batch experiments.

MP 3720

TRANSPORT OF 2,4,6-TRINITROTOLUENE AND HEXAHYDROL-1,3,5-TRINITRO-1,3,5-TRIAZINE IN SOILS.

Selim, H.M., Xue, S.K., Iskandar, I.K., *Soil science*, Nov. 1995, 100(5), p.328-339, 18 refs. 50-1688

SOIL POLLUTION, SOIL CHEMISTRY, SOIL TESTS, EXPLOSIVES, MILITARY FACILITIES

The fate and transport of explosives in soils was investigated. Transport experiments were conducted to describe the mobility of 2,4,6-trinitrotoluene (TNT) and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in a SWy-1 reference clay (bentonite mixed with sand) and two selected soils (Norwood and Kolin). Miscible displacement experiments in packed soil columns under steady flow were used. For the bentonite/sand column, TNT was highly mobile and fully reversible when methanol was used as the background solution. In contrast, with 0.005 M $\text{Ca}(\text{NO}_3)_2$ as the background solution, the TNT pulse was strongly retarded with as much as 50% of that applied remaining within the bentonite/sand, Norwood, or Kolin columns. Products of the transformation of TNT to 4-Am-DNT and other compounds were identified in the effluent solution. A 7-day flow interruption during the TNT pulse application resulted in decreased TNT levels in the effluent solution. This decrease corresponded to a sudden increase in the 4-Am-DNT concentration in the effluent, with peak concentrations of 0.60 mg/ml. For RDX, only limited retention was observed in all columns.

MP 3721

THERMOSIPHON-BASED DESIGNS AND APPLICATIONS FOR FOUNDATIONS BUILT ON PERMAFROST.

Zarling, J.P., Haynes, F.D., International Arctic Technology Conference, Anchorage, AK, May 29-31, 1991. Proceedings, Richardson, TX, Society of Petroleum Engineers, 1991, p.449-458, 16 refs. 50-1733

PERMAFROST BENEATH STRUCTURES, FOUNDATIONS, COLD WEATHER CONSTRUCTION, PIPES (TUBES), HEAT TRANSFER, SUBGRADE SOILS, SOIL TEMPERATURE, TEMPERATURE CONTROL, THERMAL DIFFUSION, SOIL STABILIZATION, PERMAFROST PRESERVATION, DESIGN

Thermosiphons have been used across Alaska and northern Canada as a means of stabilizing foundations built on permafrost. This paper describes a number of different applications including details of the installations. A brief discussion of the design methodology is also presented.

MP 3722

COMPLEXITY OF HOLOCENE CLIMATE AS RECONSTRUCTED FROM A GREENLAND ICE CORE.

O'Brien, S.R., Mayewski, P.A., Meeker, L.D., Meese, D.A., Twickler, M.S., Whitlow, S.I., *Science*, Dec.

22, 1995, 270(5244), p.1962-1964, 44 refs.

50-1797

ICE CORES, CLIMATIC CHANGES, ATMOSPHERIC COMPOSITION, ATMOSPHERIC CIRCULATION, CHEMICAL COMPOSITION, GREENLAND

MP 3723

OVERVIEW OF RECENT PROGRAM ON MECHANICAL PROPERTIES OF SEA ICE.

Cole, D.M., et al, *Journal of cold regions engineering*, Dec. 1995, 9(4), p.219-234, 22 refs. 50-1842

SEA ICE, ICE CREEP, ICE MECHANICS, ICE PHYSICS, ICE LOADS, ICE COVER THICKNESS, ICE GROWTH, ICE SALINITY, ICE STRUCTURE

MP 3724

SUB-SURFACE MELTING IN A SEASONAL SNOW COVER.

Koh, G., Jordan, R., *Journal of glaciology*, 1995, 41(139), p.474-482, 22 refs. 50-1869

SNOW COVER STABILITY, SNOW HYDROLOGY, SNOW PHYSICS, SNOWMELT, SNOW THERMAL PROPERTIES, MASS BALANCE, SNOW WATER CONTENT, WET SNOW, INSULATION, RADIATION ABSORPTION, SUBSURFACE INVESTIGATIONS, RADAR ECHOES, MATHEMATICAL MODELS

The ability of solar radiation to penetrate into a snow cover combined with the low thermal conductivity of snow can lead to a sub-surface temperature maximum. This elevated sub-surface temperature allows a layer of wet snow to form below the surface even on days when the air temperature remains sub-freezing. A high-resolution frequency-modulated continuous wave radar has been used to detect the onset of sub-surface melting in a seasonal snow cover. The experimental observation of sub-surface melting is shown to be in good agreement with the predictions of a one-dimensional mass- and energy-balance model. The effects of varying snow characteristics and solar extinction parameters on the sub-surface melt characteristics are investigated using model simulations.

MP 3725

UNIVERSAL FROST SUSCEPTIBILITY TEST APPARATUS.

Chamberlain, E.J., Transportation Research Board Annual Meeting, 1986, 35p., 1 ref. 50-1974

SOIL TESTS, MECHANICAL TESTS, PAVEMENT BASES, FROZEN GROUND MECHANICS, TEST EQUIPMENT, MEASURING INSTRUMENTS, FROST PENETRATION, FROST HEAVE, THAW WEAKENING, FREEZE THAW TESTS, LOADING, DESIGN, PERFORMANCE

A laboratory test apparatus is described that allows the determination of the frost heave and thaw weakening characteristics of granular soil for specific site conditions. This apparatus provides for freezing, thawing and repeated load triaxial testing in a single device. Actual site condition of temperature and pore water and soil stress can be simulated. The freezing test is fully automated, with programed temperature control and automated data acquisition capabilities. Each data scan provides an output showing the temperature profile, frost heave, frost depths, water elevation, and other test parameters in appropriate engineering units. The data is also stored on cassette tape and can be transferred to a plotter or mainframe computer for further analysis.

MP 3726

GRAIN-SCALE MECHANISMS INFLUENCING THE ELUTION OF IONS FROM SNOW.

Cragin, J.H., Hewitt, A.D., Colbeck, S.C., *Atmospheric environment*, 1996, 30(1), p.119-127, 20 refs. 50-1975

SNOW HYDROLOGY, SNOW PHYSICS, SNOWMELT, ION DIFFUSION, ION DENSITY (CONCENTRATION), METAMORPHISM (SNOW), ICE WATER INTERFACE, GRAIN SIZE, SNOW CRYSTAL STRUCTURE, SOLUBILITY, SNOW IMPURITIES, SIMULATION

Columns containing synthetic, naturally- or laboratory-aged snow grains were washed with deionized distilled water and with a simulated precipitation solution to investigate both chemical fractionation and preferential ion elution. The resulting elution order and concentrations of Cl^- , NO_3^- and SO_4^{2-} were not influenced by chromatographic effects, indicating that snow grains do not possess selective affinity for inorganic anions. Fractionation and preferential chemical elution were strongly influenced by ion exclusion and rearrangement processes occurring during dry snow metamorphism, independent of melt-freeze cycles.

MP 3727

MOISTURE MOVEMENT AND FREEZING PRESSURES.

Hoekstra, P., Soil Science Society of America. Annual meeting. New Orleans, LA, 1968. Symposium on freezing and thawing phenomena in soils,

1968, 14p. + appends., 11 refs.

50-1976

FROZEN GROUND THERMODYNAMICS, SOIL FREEZING, SOIL WATER MIGRATION, SOIL PRESSURE, PHASE TRANSFORMATIONS, MOISTURE TRANSFER, ICE LENSES, FREEZING FRONT, MECHANICAL TESTS, ICE WATER INTERFACE, POROSITY, ICE TEMPERATURE

Pressures develop when cylindrical columns of saturated soils are frozen unidirectionally under conditions of constant volume with an open water supply at the warm side. The value and behavior of these pressures depend on soil type. If moisture migration can take place in the frozen soil and ice lenses grow behind the freezing front, the value of the pressure depends on the temperature at the ice lens. This process occurs in clayey soils, and the pressure is theoretically limited by the phase transition ice 1-water. Values of 100 atmospheres have been measured experimentally. In soils where moisture migration in the frozen soil does not occur and ice lenses form at the freezing front, the pressure reaches a constant value, which may vary between 0.2 atmosphere for a sand soil and 3 atmospheres for a silt soil. Thermodynamic models proposed to explain these phenomena are discussed.

MP 3728

COMPARISON OF TWO TECHNIQUES FOR R-VALUE CALCULATION, USING WINTER IN-SITU DATA.

Flanders, S.N., Desjarais, A.O., Kunz, T.J., Conference on Thermal Performance of Exterior Envelopes of Buildings VI, Clearwater Beach, FL, Dec. 4-8, 1995. Proceedings, Atlanta, American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., 1995, p.151-161, 11 refs. 50-1979

BUILDINGS, THERMAL INSULATION, THERMAL ANALYSIS, COLD WEATHER PERFORMANCE, HEAT FLUX, INDEXES (RATIOS), TEMPERATURE VARIATIONS, TEMPERATURE MEASUREMENT, ANALYSIS (MATHEMATICS), ACCURACY, STANDARDS

This study employed winter *in-situ* temperature and heat flux data from a building in North Dakota and two buildings in upstate New York. The authors obtained the temperature and heat flux data according to ASTM Standard Practice C 1046-91. A proposed revision of ASTM Standard Practice C 1155 includes two calculational techniques, summation, and sum of least squares. These techniques were applied to the data obtained and the results compared. The comparison reported in this study was of the estimate of the R-value obtained, the speed at which a stable value was obtained, and an assessment of the conditions that provided the most reliable results from each calculation.

MP 3729

LABORATORY TESTING OF AIR RETARDERS IN METAL BUILDING PANELS.

Flanders, S.N., Bracken, M.S., Conference on Thermal Performance of Exterior Envelopes of Buildings VI, Clearwater Beach, FL, Dec. 4-8, 1995. Proceedings, Atlanta, American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., 1995, p.119-123, 6 refs. 50-1980

BUILDINGS, PREFABRICATION, PANELS, STEEL STRUCTURES, AIR LEAKAGE, SEALING, WIND FACTORS, AIR FLOW, FLOW CONTROL, DESIGN

The authors tested a variety of air retarder configurations for pre-engineered metal buildings. Test panels were devised to simulate a variety of configurations. The panels were tested in an ASTM E 283 apparatus that establishes a difference in air pressure across the test specimen and measures the resulting airflow through the specimen. The specimens were evaluated for their ability to impede airflow due to air pressure differences.

MP 3730

PROBABILISTIC APPROACH TO DETERMINING FROST HEAVE.

Chamberlain, E.J., Guymon, G.L., Berg, R.L., Seminar on the Prediction of Frost Heave, Nottingham, England, Apr. 9, 1981. Proceedings. Edited by R.H. Jones, University of Nottingham, p.29-50, 7 refs. 50-2141

FROZEN GROUND MECHANICS, ROAD MAINTENANCE, FROST HEAVE, MATHEMATICAL MODELS, FROST FORECASTING, UNFROZEN WATER CONTENT, ICE WATER INTERFACE, MOISTURE TRANSFER, SOIL WATER MIGRATION

A deterministic model of frost heave is coupled with a probabilistic model of parameter variation to predict frost heave. The model is particularly sensitive to variations in hydraulic parameters, the coefficient of variation of unfrozen hydraulic conductivity primarily determining the coefficient of variation of simulated frost heave. A probabilistic approach to determining differential frost heave is also presented. This method relies on knowing the natural variation in input soil parameters beneath a test road. The distribution of percent of soil particles finer than 0.02 mm is identified as a possible key to the distribution of the other soil parameters necessary for the model calculations. Upon completion of moisture characteristic and hydraulic conductivity tests, calcu-

lated differential heaves will be compared with observed values.

MP 3731
THICKNESS, STRUCTURE, AND PROPERTIES OF LEVEL SUMMER MULTIYEAR ICE IN THE EURASIAN SECTOR OF THE ARCTIC OCEAN.

Eicken, H., Lensu, M., Leppäranta, M., Tucker, W.B., Gow, A.J., Salmela, O., *Journal of geophysical research*, Nov. 15, 1995, 100(C11), p.22,697-22,710, 53 refs.

50-2112
SEA ICE DISTRIBUTION, OCEANOGRAPHY, ICE COVER THICKNESS, ICE SURVEYS, CLASSIFICATIONS, ICE CORES, STRATIGRAPHY, ICE MICROSTRUCTURE, SAMPLING, ICE WATER INTERFACE, SALINITY, PHYSICAL PROPERTIES, ABLATION, CORRELATION, ARCTIC OCEAN

In Aug. and Sep. 1991, thickness, structure and properties of level multiyear ice were studied at 66 locations in the Eurasian sector of the Arctic Ocean. The mean ice thickness was 2.86 m, with 0.31 m of freeboard. On the basis of the study of ice cores, 61% of the ice cover consisted of undeformed columnar ice, the remaining 39% consisted of a mixture of ice types including frazil (18%) and deformed ice (9%). Through microstructural studies, six main classes of pores could be identified. The mean density of the ice cover increased from 720 kg/m³ at the top to >880 kg/m³ below 0.4 m depth. Sea ice salinities (mean value 2.1 per mill) correlate with ice thickness. On average, salinity profiles exhibit a linear increase from values close to 0 per mill at the top to 2 per mill at 1 m depth, with less steep salinity gradients below. Sampling from different depths within the ice cover indicates that the brine in summer sea ice is strongly stratified. The influence of meltwater percolation is evident, with salinities around 5 per mill and pH values <8 at the top and >15 per mill and >8 at greater depths. Pore microstructure is highly variable even on small scales. Salinity and other ice properties do not vary to a large degree between different regions. The evolution of level multiyear sea ice is discussed with particular reference to "hidden" occurrence of deformed ice and the importance of ablation processes.

MP 3732
DRIFTED SNOW AFFECTS MOMENTUM EXCHANGE OVER SEA ICE.

Andreas, E.L., Claffey, K.J., *Antarctic journal of the United States*, 1994, 29(5), p.89-91, 9 refs.

50-2220

SNOWDRIFTS, BLOWING SNOW, WIND FACTORS, SEA ICE, ANTARCTICA—WEDDELL SEA
On Ice Station Weddell-1 (ISW-1), hourly surface level observations of many meteorological quantities were carried out almost continuously from Feb. 25 to May 29, 1992, including observations of drifting and blowing snow. The authors have combined these observations of wind-driven snow with hourly averaged wind speed at a height of 5 m and show the result in a figure, where the primary distinction is between drifting and blowing snow: drifting snow is below eye level; blowing snow is above eye level, and thus obscures visibility. The point that the figure establishes is that, on ISW-1 at fairly modest wind speeds (6-8 m/s), some form of wind-driven snow was present about 60% of the time. When the wind exceeds 6-8 m/s, it begins eroding any snowdrifts at right angles to it and deposits this snow to streamline the surface in the current wind direction. Consequently, if these high winds persist, the snow surface gets more streamlined as the drifts build.

MP 3733
CONCEPTS FOR FROST DESIGN FOR UPGRADED RUNWAY AT CONUS BASE 18.

Johnson, T.C., U.S. Army Cold Regions Research and Engineering Laboratory, May 1984, 17p.

50-2308

RUNWAYS, PAVEMENT BASES, SUBGRADE SOILS, COLD WEATHER PERFORMANCE, FROST RESISTANCE, FROST ACTION, DESIGN CRITERIA, DRAINAGE, STANDARDS

The author examined airfield pavements, conferred with engineering and operations personnel at the base, and reviewed previous design reports, as-built drawings, condition survey reports and pavement evaluation reports, including a report on a pavement evaluation conducted in 1983. Results of test pits and laboratory soil tests conducted within the past month for USAED Seattle were also reviewed. Based on information from all these sources, the existing pavements of principal interest and pertinent soil, drainage and climatic conditions at the site were described, in an evaluation of frost resistance design criteria.

MP 3734
PREDICTIVE MODEL OF FROST HEAVE AND THAW WEAKENING.

Guymon, G.L., Berg, R.L., Chamberlain, E., Transportation Research Board, Annual Meeting, 1986. Paper, 1986, 17p., 12 refs.

50-2310

ROAD MAINTENANCE, PAVEMENT BASES, DEFORMA-

TION, SOIL FREEZING, FROST HEAVE, FROST FORECASTING, THAW WEAKENING, THAW CONSOLIDATION, FROST PENETRATION, MECHANICAL TESTS, MATHEMATICAL MODELS

A dynamic mathematical model to compute frost heave, frost and thaw penetration, pore water pressure (or tension), and temperatures with depth and time was developed in a cooperative study between the Federal Highway Administration, the Federal Aviation Administration and the U.S. Army Corps of Engineers. Application of the model to field and laboratory tests is discussed. Results from the model compare favorably with measurements made in the laboratory and in the field. A silty sand is used in all of the examples. It is one of eight soils to which the model has been applied. Field data indicated a maximum frost heave of about 9 cm and the model estimated a similar amount. Maximum frost depth measured in the field was about 0.77 m while the model estimated a frost depth of about 0.60 m. Maximum resilient pavement deflection computed using output from the model was about 1.4 mm compared to an observed maximum of approximately the same amount.

MP 3735
CAN INORGANIC CHEMICAL SPECIES VOLATILIZE FROM SNOW.

Cragin, J.H., McGilvary, R., International Association of Hydrological Sciences. Publication No.228 and International Symposium on Biogeochemistry of Seasonally Snow-covered Catchments, Boulder, CO, July 1-14, 1995. Proceedings. Edited by K.A. Tonnessen et al, Great Yarmouth, 1995, p.11-16, 10 refs.

50-2393

SNOW COVER STABILITY, SAMPLING, SNOW PHYSICS, SNOW COMPOSITION, SNOW IMPURITIES, AEROSOLS, SUBLIMATION, SNOW EVAPORATION, SNOW AIR INTERFACE, CHEMICAL PROPERTIES, ION DIFFUSION, MASS TRANSFER

To determine if reported time-decreasing concentrations of nitrate and sulfate in winter snowpacks could be due to loss of these species through the gas phase, i.e. volatilization, freshly-falling snow was collected and allowed to slowly sublime at -5°C under controlled laboratory conditions. When 20-50% of the original water mass had sublimed, samples were melted and analyzed for chloride, nitrate, and sulfate. In two separate experiments, chloride and nitrate behaved conservatively and were fully recovered while sulfate losses of as much as 38% occurred during a 1-month period. These losses raise questions about the long-term stability of SO₄²⁻ in both temporal and polar snowpacks.

MP 3736
VENTILATION EXPERIMENTS IN A SEASONAL SNOW COVER.

Albert, M.R., Hardy, J.P., International Association of Hydrological Sciences. Publication No.228 and International Symposium on Biogeochemistry of Seasonally Snow-covered Catchments, Boulder, CO, July 1-14, 1995. Proceedings. Edited by K.A. Tonnessen et al, Great Yarmouth, 1995, p.41-49, 12 refs.

50-2397

SNOW PHYSICS, SNOW COVER, SNOW THERMAL PROPERTIES, SNOW AIR INTERFACE, SNOW SURFACE TEMPERATURE, VENTILATION, VAPOR DIFFUSION, AIR FLOW, ATMOSPHERIC PRESSURE, HEAT TRANSFER, SNOW PERMEABILITY

The effects of induced air flow through a layered, seasonal snowpack due to an imposed horizontally varying surface pressure distribution are described. Results of a field experiment show that the thermal signature of air flow through the snow occurred within minutes of imposition of a surface pressure disturbance and became evident over much of the 28-cm deep snowpack. In this low-density snowpack, small pressure variations (less than three Pascals) were sufficient to cause significant air movement in the pack. Numerical heat and mass transfer simulations of the experiment are described. There is good agreement between model calculations and measured snowpack temperatures, which demonstrate diffusion-controlled heat transfer before the onset of air flow, advection-controlled transfer during the ventilation, and return to diffusion-dominated transport after ventilation ceased.

MP 3737
EVOLUTION OF FACTORS AFFECTING GAS TRANSMISSIVITY OF SNOW IN THE BOREAL FOREST.

Hardy, J.P., Davis, R.E., Winston, G.C., International Association of Hydrological Sciences. Publication No.228 and International Symposium on Biogeochemistry of Seasonally Snow-covered Catchments, Boulder, CO, July 1-14, 1995. Proceedings. Edited by K.A. Tonnessen et al, Great Yarmouth, 1995, p.51-59, 14 refs.

50-2398

FOREST ECOSYSTEMS, FOREST CANOPY, ATMOSPHERIC COMPOSITION, SNOW COVER STABILITY, SNOWMELT, SNOW AIR INTERFACE, SOIL AIR INTERFACE, VAPOR DIFFUSION, SNOW PERMEABILITY, CARBON DIOXIDE, GEOCHEMISTRY, SEASONAL VARIATIONS

Factors influencing CO₂ transmission from the soil through snow to the atmosphere during the boreal winter and spring were examined. Three boreal forest structures of northern Manitoba were investigated for their influence on snow distribution, snowpack physical properties, and gas transmissivity. The structure of each forest was measured, as was snow depth variability, snowpack physical properties, and CO₂ flux at the snow surface. During February, measured snow surface CO₂ fluxes were at their minimum despite the highly porous and permeable character of the snowpack. Very low soil temperatures and gas production rates were responsible for the low fluxes. In April, measured CO₂ fluxes were higher, but extremely variable in all forests.

MP 3738
SEASONAL VARIABILITY IN CO₂ TRANSPORT THROUGH SNOW IN A BOREAL FOREST.

Winston, G.C., Stephens, B.B., Sundquist, E.T., Hardy, J.P., Davis, R.E., International Association of Hydrological Sciences. Publication No.228 and International Symposium on Biogeochemistry of Seasonally Snow-covered Catchments, Boulder, CO, July 1-14, 1995. Proceedings. Edited by K.A. Tonnessen et al, Great Yarmouth, 1995, p.61-70, 23 refs.

50-2399

FOREST ECOSYSTEMS, FOREST SOILS, SNOW COVER STABILITY, SNOW AIR INTERFACE, SNOW COVER EFFECT, SNOW PHYSICS, CARBON DIOXIDE, VAPOR DIFFUSION, ATMOSPHERIC COMPOSITION, GEOCHEMISTRY, SOIL TEMPERATURE, SEASONAL VARIATIONS

A chamber method was used to measure CO₂ flux at the surface of the snowpack within three ecotypes of a northern boreal forest near Thompson, Manitoba during the winter and spring of 1993-94. Also measured were temperatures and CO₂ concentrations at depth within the soil. Vertical concentration gradients, which were observed throughout the winter, declined as soil temperatures dropped and quickly increased when soil temperatures rose. The changing gradients may have been caused by changes in both CO₂ production and the diffusive characteristics of the soil and/or snow. CO₂ fluxes occurred at the snow surface at all sites throughout the winter. Fluxes were lowest in mid to late February and highest in April. Channeling by inhomogeneities of the snowpack contributed to a high degree of spatial variability. These inhomogeneities appeared as depth hoar, ice structures, density variations, and the seasonal formation of melt wells and ablation rings.

MP 3739
SOIL-TO-SNOW MOVEMENT OF SYNTHETIC ORGANIC COMPOUNDS IN NATURAL SNOWPACK.

Hogan, A., Leggett, D., International Association of Hydrological Sciences. Publication No.228 and International Symposium on Biogeochemistry of Seasonally Snow-covered Catchments, Boulder, CO, July 1-14, 1995. Proceedings. Edited by K.A. Tonnessen et al, Great Yarmouth, 1995, p.97-105, 21 refs.

50-2403

SOIL TESTS, SNOW PHYSICS, SNOW PERMEABILITY, GEOCHEMISTRY, HYDROCARBONS, SNOW COMPOSITION, MELTWEATER, SNOW AIR INTERFACE, SOIL AIR INTERFACE, MASS TRANSFER, VAPOR DIFFUSION, SAMPLING

Experiments were done to measure the exchange of relatively insoluble organic tracers from soil to snow, and movement of organic tracer compounds in natural snow, using assorted nitroaromatics as tracer species. These compounds are not found in measurable quantity in native soil or snow, and there is little probability of sample contamination in routine sampling and handling. Snow specimens were collected over the tracer sources after 3 to 75 days had elapsed, in snow depths of less than 10 to more than 70 cm. The concentration of the tracer compounds is measured in the sample meltwater. The concentration of organic compounds of slight solubility and vapor pressure less than 10⁻³ mm Hg (DNT, TNT, nitrotyrosine) tend to acquire a concentration profile in the overlying snow that is exponential with the distance above the source. The concentration increases with elapsed time in dry snow. Concentration profiles obtained near but not over the source indicate that the tracer material disperses over less distance horizontally than vertically in dry snow.

MP 3740
ION FLUX THROUGH A SHALLOW SNOWPACK: EFFECTS OF INITIAL CONDITIONS AND MELT SEQUENCES.

Davis, R.E., Petersen, C.E., Bales, R.C., International Association of Hydrological Sciences. Publication No.228 and International Symposium on Biogeochemistry of Seasonally Snow-covered Catchments, Boulder, CO, July 1-14, 1995. Proceedings. Edited by K.A. Tonnessen et al, Great Yarmouth, 1995, p.115-126, 21 refs.

50-2405

SNOW COVER STABILITY, SNOW PHYSICS, SNOW HYDROLOGY, SNOWMELT, FREEZE THAW CYCLES,

MELTING POINTS, ION DIFFUSION, SNOW IMPURITIES, ION DENSITY (CONCENTRATION), MASS TRANSFER, ICE WATER INTERFACE, SIMULATION, COLD CHAMBERS

Six snowmelt experiments were carried out under controlled conditions in a cold room to examine the effects of melt rate, melt-freeze cycles, and initial chemical distribution on the ionic pulse from a physically homogeneous snowpack. The experiment snow volume was 1 m³ in cross-sectional area and 0.4 m deep. Different initial distributions of chemical species were prepared by introducing tracers at different stages of sieving snow into the snow container. Constant slower rates of melting caused a more pronounced removal of ions, as observed in the initial meltwaters, than did higher rates. Long melt-freeze cycles applied to a chemically homogeneous snowpack concentrated impurities at the base of the pack and produced the greatest ionic concentration in the initial meltwater collected. Short melt-freeze cycles were less effective at elevating concentrations of trace species in the initial meltwaters. As with previous experiments, the initial distribution of impurities was shown to influence the magnitude of the ionic pulse. Chemical species applied to a layer at mid-depth in the snowpack were removed slower than species applied to a layer on the top.

MP 3741 CHEMICAL AND ISOTOPIC EVOLUTION OF A LAYERED EASTERN U.S. SNOWPACK AND ITS RELATION TO STREAM-WATER COMPOSITION.

Shanley, J.B., Kendall, C., Albert, M.R., Hardy, J.P., International Association of Hydrological Sciences. Publication No.228 and International Symposium on Biogeochemistry of Seasonally Snow-covered Catchments, Boulder, CO, July 1-14, 1995. Proceedings. Edited by K.A. Tonnessen et al, Great Yarmouth, 1995, p.329-338, 17 refs.

50-2425
WATERSHEDS, HYDROGEOCHEMISTRY, HYDROGRAPHY, SNOW HYDROLOGY, SNOWMELT, SNOW COMPOSITION, STRATIFICATION, ION DIFFUSION, METAMORPHISM (SNOW), SAMPLING, SNOW COVER EFFECT, ISOTOPE ANALYSIS
The chemical, isotopic, and morphologic evolution of a layered snowpack was investigated during the winter of 1993-94 at Sleepers River Research Watershed in Danville, VT. The snowpack was monitored at two small basins: a forested basin at 525 m elevation, and an agricultural basin at 292 m elevation. At each site, the snowpack morphology was characterized and individual layers were sampled seven times during the season. Nitrate and $\delta^{18}\text{O}$ profiles in the snowpack remained relatively stable until peak accumulation in mid-March, except near the snow surface, where rain-on-snow events caused water and nitrate movement down to impeding ice layers. Subsequently, water and nitrate moved more readily through the ripening snowpack. As the snowpack evolved, combined processes of preferential ion elution, isotopic fractionation, and infiltration of isotopically heavy rainfall caused the pack to become depleted in solutes and isotopically enriched. The release of nitrate and isotopically depleted water was reflected in patterns of nitrate concentrations and $\delta^{18}\text{O}$ of meltwater and stream water.

MP 3742 DEVELOPMENT OF A FIELD METHOD FOR AMMONIUM PICRATE/PICRIC ACID IN SOIL AND WATER.

Thorne, P.G., Jenkins, T.F., International symposium, Las Vegas, NV, Feb. 22-24, 1995. Field screening methods for hazardous wastes and toxic chemicals. VIP-47, Vol.2, Pittsburgh, Air & Waste Management Association, 1995, p.942-947, 11 refs.

50-2440
SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, SOIL ANALYSIS, EXPLOSIVES
Methods for the detection and quantification of ammonium picrate and picric acid in soil and water were developed. Picrate ions were extracted from water directly or from acetone extracts of soil by acidic ion-exchange materials. Elution from the ion-exchangers was accomplished by converting the retained picrate to picric acid using strong aqueous acid/organic solvent mixtures. The resulting colorless solution was then converted back to a colored picrate solution by dilution with water. Quantification and correction for background interferences was based on spectrophotometric measurements. A chemical confirmation of picrate is possible for the water method. Method Detection Limits (MDLs) are 1.3 ppm for soil and 3.6 ppb for water. Both methods can be implemented under field conditions.

MP 3743 INTERLABORATORY EVALUATION OF VOLATILE ORGANIC COMPOUND DETERMINATION IN SOILS PREPARED BY VAPOR FORTIFICATION.

Hewitt, A.D., Grant, C.L., International symposium, Las Vegas, NV, Feb. 22-24, 1995. Field screening methods for hazardous wastes and toxic chemicals. VIP-47, Vol.2, Pittsburgh, Air & Waste Management

Association, 1995, p.1207-1212, 9 refs.

50-2441 SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, SOIL ANALYSIS

The feasibility of using vapor fortification to prepare secondary soil standards containing volatile organic compounds (VOCs) was evaluated by an interlaboratory study. Twelve laboratories used EPA Method 8240 (SW846) to analyze two independently prepared subsamples of three different soil matrices fortified with trans-1,2-dichloroethylene (TDCE), trichloroethylene (TCE), benzene (Ben), and toluene (Tol). A quality assurance (QA) standard with certified concentrations of TCE, Ben, and Tol (no TDCE) was also analyzed. The pooled relative standard deviation (RSD) for the QA standard was 7.8%, while the same analytes in the soils produced a pooled RSD of 10.4%. Agreement of these precision estimates is excellent, considering that soil analysis required an extraction step while the QA standard was solvent (methanol) based. TDCE in the soils yielded less precise results (pooled RSD of 20.3%), presumably because of its high volatility.

MP 3744 SCREENING FOR METALS BY PORTABLE XRF USING FUNDAMENTAL PARAMETER ANALYSIS AND SINGLE REFERENCE STANDARD CALIBRATION.

Hewitt, A.D., International symposium, Las Vegas, NV, Feb. 22-24, 1995. Field screening methods for hazardous wastes and toxic chemicals. VIP-47, Vol.2, Pittsburgh, Air & Waste Management Association, 1995, p.1309-1321, 18 refs.

50-2442
SOIL POLLUTION, SOIL TESTS, SOIL CHEMISTRY, SOIL ANALYSIS, METALS, X RAY ANALYSIS
Soils and other particle matrices were analyzed for copper, zinc, arsenic, lead, chromium, cobalt, nickel, mercury, thallium, selenium, silver, antimony, cadmium, tin, and barium using transportable high-resolution X-ray fluorescence (XRF) spectrometers. Quantitative determinations for these metals were based on fundamental parameter analysis and a method that uses a single calibration standard. Both of these methods were assessed to see if they were capable of circumventing the need to acquire matrix matched standards when screening for metals in a variety of environmental matrices. With the exception of nickel, cobalt and chromium, concentrations within 50% of the expected values were routinely obtained at and below 1000 µg/g in soils.

MP 3745 SMART WEAPONS OPERABILITY ENHANCEMENT (SWOE) JOINT TEST AND EVALUATION (JT&E) PROGRAM. FINAL REPORT.

Welsh, J.P., U.S. Army Cold Regions Research and Engineering Laboratory. SWOE report, Aug. 1994, No.94-10, Var. p., ADB-194 042, 27 refs.

50-2453
TERRAIN IDENTIFICATION, INFRARED PHOTOGRAPHY, INFRARED RECONNAISSANCE, ENVIRONMENT SIMULATION, DATA TRANSMISSION, IMAGE PROCESSING, COMPUTER PROGRAMS, MILITARY RESEARCH, MILITARY OPERATION, MILITARY EQUIPMENT

MP 3746 MULTIDIMENSIONAL STEADY CONDUCTION IN CONVECTING, RADIATING, AND CONVECTING-RADIATING FINS AND FIN ASSEMBLIES.

Aziz, A., Lunardini, V.J., *Heat transfer engineering*, 1995, 16(3), p.32-64, 61 refs.

50-2455
HEAT TRANSFER, HEAT LOSS, HEAT SINKS, CONDUCTION, CONVECTION, THERMAL RADIATION, COOLING SYSTEMS, MATHEMATICAL MODELS

This article reviews the literature on multidimensional heat conduction in single fins and fin assemblies. The surface heat dissipation mechanisms include pure convection, pure radiation, and simultaneous convection and radiation. Two-dimensional heat transfer results are presented for longitudinal, radial, and cylindrical fins. The discussion also covers square and polygonal fins on round tubes and composite fins. These heat transfer results encompass a variety of situations, such as a nonconstant base temperature, nonuniform ambient temperature, asymmetric thermal boundary conditions, anisotropy of fin material, variable heat transfer coefficient, and internal heat generation. The article provides a comprehensive collection of important analytical and numerical results for two-dimensional effects in extended surfaces, hence, both scientific and practice-oriented heat transfer workers would find the information convenient to use for analysis and design.

MP 3747 MATERIAL INTERACTIONS WHEN SAMPLING GROUNDWATER.

Parker, L.V., Department of Defense Environmental Technology Workshop, Hershey, PA, May 22-24, 1995, Aberdeen Proving Ground, MD, U.S. Army

Environmental Center, 1995, p.317-324, 20 refs.

50-2456 SOIL POLLUTION, WATER POLLUTION, GROUND WATER, WELLS, WELL CASINGS, SOIL TESTS, SOIL ANALYSIS, SOIL CHEMISTRY, WATER CHEMISTRY

MP 3748 GROUND-COUPLED HEAT PUMPS FOR FAMILY HOUSING UNITS.

Phetteplace, G., U.S. Army Center for Public Works, Alexandria, VA. *Facilities Engineering Applications Program. Technical report. User guide*, Mar. 1995, FEAP-UG-CRREL-95/01, 19p., 7 refs.

50-2459
RESIDENTIAL BUILDINGS, HOUSES, HEAT PUMPS, HEAT PIPES, HEAT RECOVERY, GEOTHERMY

MP 3749 EVALUATION OF THE GEOTHERMAL HEAT PUMP INSTALLATION AT NAVAL AIR STATION, PATUXENT RIVER.

Garg, S., Phetteplace, G., U.S. Naval Facilities Engineering Service Center. *Technical memorandum*, Oct. 1995, TM-2157-E&U, 3p. + figs., 1 ref. For an earlier version see 49-1412.

50-2460
BUILDINGS, MILITARY FACILITIES, HEAT PUMPS, GEOTHERMY

MP 3750 SNOW-INDUCED THERMAL VARIATIONS AROUND A SINGLE CONIFER TREE.

Hardy, J.P., Albert, M.R., *Hydrological processes*, 1995, Vol.9, p.923-933, 19 refs.

50-2461
SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW DEPTH, SNOW ACCUMULATION, SNOW HEAT FLUX, SNOW HYDROLOGY, SNOWMELT, RUNOFF PENETRATION, VEGETATION FACTORS, FOREST CANOPY, INTERCEPTION, RUNOFF FORECASTING
The influence of trees on the ground thermal regime is important to the overall winter energy exchange in a snow-covered, forested watershed. In this work, spatial zones around a single conifer tree were defined and examined for their controls on the snow cover, snow-ground interface temperatures and frozen ground extent. A large white spruce (*Picea glauca*), approximately 18 m tall with a crown diameter of 7.5 m and located in northern Vermont, was the subject of this study. The tree was instrumented with thermistors to measure the snow-ground interface temperature between the tree trunk and 6 m from the tree into undisturbed snow. Four distinct zones around the conifer are defined that affect the snow distribution characteristics: adjacent to the trunk; the tree wall; the tree crown perimeter; and the unaffected area away from the tree. At the time of peak snow accumulation and during the ablation season, snow depth and density profiles were measured. The area beneath the canopy accumulated 34% of the snow accumulated in the undisturbed zone. By the end of the ablation season, the depth of snow under the canopy had decreased to 18% of the undisturbed snow depth. The tree and branch characteristics of spruce in this temperate climate resulted in a different snow depth profile compared with previous empirical relationships around a single conifer. A new relationship is presented for snow distribution around conifer trees that has the ability to better fit data from a variety of conifer types than previously published relationships.

MP 3751 DISTRIBUTED SNOW PROCESS MODELLING: AN IMAGE PROCESSING APPROACH.

Davis, R.E., McKenzie, J.C., Jordan, R., *Hydrological processes*, 1995, Vol.9, p.865-875, 14 refs.

50-2462
SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW DEPTH, SNOW DENSITY, SNOW HEAT FLUX, SNOW HYDROLOGY, SNOWMELT, RUNOFF FORECASTING, COMPUTERIZED SIMULATION

An approach to spatially distribute a snow process model by segmenting images of land cover, terrain and snow properties is reported. A small 1.7 ha study area with an existing database was selected for this preliminary evaluation. The methodology was carried out over a relatively flat valley bottom at Camp Grayling, MI. Meteorological measurements on two sides of the area showed only small differences, so uniform meteorological variables were assumed over the site. Initial snow cover conditions were reconstructed and were distributed over the area using snow maps and sparse snow pit measurements. One meter resolution terrain, soil, vegetation and snow type maps were individually processed into class maps. These layers were then combined to produce a segmented class map, where the attributes from the data layers were known for each class. A one-dimensional model of snow processes was run for each class, then the results were mapped back into images. Shallow snow conditions provided high sensitivity of ablation patterns to meteorological conditions over a 72 h period. The model performance was assessed by comparing predicted and observed ablation patterns. The error in total snow-covered area was less than 9%. However, the location errors were greater (predicted snow where no snow was observed

and observed snow where no snow was predicted). Extensive error analysis was not justified because of the lack of multiple point measurements of snow properties.

MP 3752 GROUND-COUPLED HEAT PUMPS.

Phetteplace, G., USACE Electrical and Mechanical Engineering Training Conference, St. Louis, MO, June 5-9, 1995. Proceedings, Fort Belvoir, VA, U.S. Army Corps of Engineers, 1995, p.748-765, 8 refs. 50-2465

RESIDENTIAL BUILDINGS, HEAT PUMPS, GEOTHERMY, HEAT PIPES, HEAT TRANSFER, HEAT RECOVERY, RADIANT HEATING, COOLING SYSTEMS

MP 3753

HOPKINSON BAR PERFORATION OF LAMINATED COMPOSITE.

Nwosu, S.N., Sivapuram, S.K., Dutta, P.K., Hui, D., International Conference on Composites Engineering, 2nd, New Orleans, Aug. 21-24, 1995. ICCE/2. Edited by D. Hui, New Orleans, University, International Community for Composites Engineering, p.559-560, 4 refs. 50-2466

COMPOSITE MATERIALS, CONSTRUCTION MATERIALS, IMPACT TESTS, PENETRATION TESTS, SHOCK WAVES, STRAIN MEASURING INSTRUMENTS

A high energy split Hopkinson pressure bar was developed at Dillard University to investigate basic wave propagation phenomena in composite materials subjected to high strain perforation loading conditions. A procedure was established to quantify energy expended in the perforation process where the absorbed energy is a relative measure of the material strength and damage process. This paper describes the basic features of the Hopkinson bar system for dynamic loading conditions to elucidate the characteristics of the perforation process, the nature of the energy absorption process, and to explain and predict the extent of damage sustained during high strain rate perforation.

MP 3754

STRENGTHENING AND REINFORCING CONCRETE WITH COMPOSITES.

Dutta, P.K., Lampo, R.G., International Conference on Composites Engineering, 2nd, New Orleans, Aug. 21-24, 1995. ICCE/2. Edited by D. Hui, New Orleans, University, International Community for Composites Engineering, p.203-204, 13 refs. 50-2467

COMPOSITE MATERIALS, PLASTICS, REINFORCED CONCRETES, CONCRETE STRENGTH

Fiber reinforced plastic (FRP) reinforcements have recently received increasing attention as the reinforcing elements in concretes as long rods, gratings, pre-tensioning or post-tensioning cables, and plates or wraps of laminates or woven fabrics of reinforcing fibers. This paper reviews some of these FRP reinforcing or repairing elements of concrete.

MP 3755

INFLUENCE OF MOISTURE ON FRP COMPOSITES.

Bhattacharya, R.K., Dutta, P.K., Hui, D., International Conference on Composites Engineering, 2nd, New Orleans, Aug. 21-24, 1995. ICCE/2. Edited by D. Hui, New Orleans, University, International Community for Composites Engineering, p.63-64, 7 refs. 50-2468

COMPOSITE MATERIALS, PLASTICS, CONSTRUCTION MATERIALS, MOISTURE TRANSFER

Fiber reinforced plastic (FRP) composites represent a new class of materials, the excellent durability of which is the primary reason for their use in many long term applications of structural elements. FRP composites are also attractive materials for construction of offshore structures. However, when a specific application of FRP composites is contemplated, it is essential for the designers to know not only the answers to questions regarding strength and stiffness, but also the questions of how long the material will last under the conditions anticipated. It is to be noted that FRP composites absorb moisture which changes the properties of resins and thus plays a crucial role on the life cycle of these composites. This paper briefly deals with the effects of absorbed moisture on the mechanical properties of FRP composites.

MP 3756

EFFECTS OF CAPILLARY DISCONTINUITIES ON WATER FLOW AND WATER RETENTION IN LAYERED SNOWCOVERS.

Jordan, R., *Defence science journal*, Apr. 1995, 45(2), p.79-91, 15 refs. For another version see 49-903.

50-2472

SNOW HYDROLOGY, SNOWMELT, SNOW PERMEABILITY, SNOW STRATIGRAPHY, SNOW HEAT FLUX, SNOW

WATER EQUIVALENT, SEEPAGE, CAPILLARITY, WATER FLOW, WATER RETENTION

The effect of capillary barriers in layered snowcovers has been examined through use of a numerical mass and energy balance model, laboratory tests and field tests. The degree of suction within the layers has been related to capillary rise and in turn to snow porosity and grain size. The relative importance of permeability and capillary tension on liquid water levels has been examined and it was concluded that capillary discontinuities play a dominant role. It has been shown both theoretically and experimentally that high-over-low suction transitions lead to interruption of water flow vertically and to horizontal movement along discontinuities. Infiltration rates predicted by the numerical model are low because of the omission of finger flow. A more realistic rendering would require a three-dimensional model or incorporate the empirical approach of Marsh and Woo.

MP 3757

COMPARISON OF INFRARED RADIOMETERS USED TO GATHER BACKGROUND SIGNATURE DATA.

Berger, R.H., Bleiweiss, M.P., *SPIE—The International Society for Optical Engineering. Proceedings*, 1995, Vol.2469, Targets and backgrounds: characterization and representation, Orlando, FL, Apr. 17-19, 1995. Edited by W.R. Watkins and D. Clement, p.576-586, 6 refs. 50-2474

TERRAIN IDENTIFICATION, RADIOMETRY, INFRARED PHOTOGRAPHY, INFRARED RECONNAISSANCE, MILITARY OPERATION, MILITARY RESEARCH, MILITARY EQUIPMENT

Over the past several years there has been a large quantity of infrared target and background signature data collected using imaging radiometers. As with any data, one of the primary questions that must be answered is, "How has the measurement system affected the data?" During the Smart Weapons Operability Enhancement (SWOE) signature measurement program this question was addressed using two "identical" AGEMA 880 dual-band radiometer systems. These two systems were used to determine how much of the variation that is observed in the signature data can be accounted for by measurement system differences. Measurements were made at the Yuma Proving Ground over a 47 day period from Mar. 15 to Apr. 30, 1993. The radiometers were mounted side-by-side and the fields of view registered as closely as possible. Most of the background signature measurements were preceded by simultaneous blackbody measurements with all four radiometers. The blackbody measurements were used to compare the performance of the two systems under the various weather conditions experienced during the measurement period. The blackbody measurements have shown that over an ambient temperature range of almost 40°C the variation between radiometer pairs was less than 1°C for the long-wave (8-12 µm) and less than 2.5°C for the short-wave (3-5 µm).

MP 3758

TALL AND HARD FESCUE RESPONSES TO PERIODIC SOIL WATER DEFICITS.

Brar, G.S., Palazzo, A.J., *Journal of agronomy & crop science*, 1995, Vol.175, p.221-229, 29 refs. 50-2475

GRASSES, ROOTS, PLANT ECOLOGY, PLANT PHYSIOLOGY, TRANSPIRATION, REVEGETATION, LAND RECLAMATION, SOIL CONSERVATION, SOIL STABILIZATION

Tall (*Festuca arundinacea* Schreb.) and hard (*Festuca ovina* var. *longifolia* (L.) Koch) fescues are widely sown to stabilize disturbed soils in the cool-humid and transition climatic zones of the U.S. The objectives of this study were to: a) quantify changes in the allocation of dry matter and growth of tall and hard fescue, forced to grow on stored soil water in sandy soil; and b) compare dry matter allocation over time between roots and shoots to evaluate the dynamics of root-associated drought-avoidance mechanisms. A randomized complete block experiment with four replications and two factors (species and stress level) was conducted in a greenhouse. The main blocks consisted of two fescue species: tall fescue and hard fescue; sub-blocks contained stress levels: well-watered and stressed. Low, medium and severe stresses were imposed by withholding water in one set of pots. The types of fescue species grown significantly affected leaf area, plant height, water use, root length, longest root, root area, shoot and root dry biomass, and root:shoot ratio. In conclusion, hard fescue had a shallower root system, shorter plant canopy, slower growth, and transpired less water to make it more drought tolerant. Tall fescue, with a deeper root system, longer plant canopy, faster growth and greater water transpiration, is less drought-tolerant at medium and severe stresses. Root attributes strongly correlated with shoot attributes and can be considered for breeding programs promoting drought tolerance.

MP 3759

USE OF FROZEN GROUND TECHNIQUES IN CONSTRUCTION.

Sanger, F.J., ASCE Structural Engineering Conference, Seattle, WA, May 8-12, 1967. Conference preprint, No.514, New York, American Society of Civil

Engineers, 1967, 46p., 32 refs.

50-2478

SOIL FREEZING, ARTIFICIAL FREEZING, SOIL STABILIZATION, FROZEN GROUND THERMODYNAMICS, FROZEN GROUND STRENGTH, FROZEN GROUND COMPRESSION

A brief discussion on the mechanical and thermal properties of frozen soils leads to design techniques for retaining-structures of artificially-frozen soils, followed by notes on field practice. Frozen soils are not elastic, and the formation of ice in soil demands a special treatment of heat conduction. Examples of design for two soils and two types of wall are given.

MP 3760

1994-1995 ANTARCTIC FIELD SEASON.

Roberts, C.A., Jatko, J.A., Lynch, J.T., Rand, J.H., *Society of Automotive Engineers. SAE technical paper series*, 1995, No.951657, 7p., 17 refs. Presented at the 25th International Conference on Environmental Systems, San Diego, CA, July 10-13, 1995. 50-2477

RESEARCH PROJECTS, STATIONS, LOGISTICS, WATER SUPPLY, WASTE DISPOSAL, ANTARCTICA—AMUNDSEN-SCOTT STATION, ANTARCTICA—MCMURDO STATION

MP 3761

FROZEN GROUND STRENGTH CHARACTERIZATION AND GROUTER CUTTER DESIGN FOR HARDENING TRANSITION, AND MOBILITY OVER SNOW COVERED TERRAIN FOR THE MOBILE TEST BED. FINAL DRAFT REPORT.

Chamberlain, E.J., Mellor, M., Abele, G., U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, Oct. 1988, 35p. + append., 3 refs. 50-2524

MILITARY EQUIPMENT, FROZEN GROUND MECHANICS, FROZEN GROUND STRENGTH, SHEAR STRENGTH, PARTICLE SIZE DISTRIBUTION, MECHANICAL TESTS, VEHICLES, STABILITY, COLD WEATHER PERFORMANCE, COLD WEATHER TESTS, TRACTION, SNOW COVER EFFECT, ICE SOLID INTERFACE

During the winter season of 1987-1988, CRREL staff participated in the continuing evaluation of the mobility and hardening capabilities of the Air Force Ballistic Office's (BMO) Mobile Test Bed (MTB), a pre-prototype model of the Hard Mobile Launcher (HML) being evaluated for deployment under the U.S. Air Force Small ICBM Program. This was the second winter test in Montana for which CRREL was contracted with by BMO to help in the evaluation of the performance of this vehicle under winter conditions. In the event of an alert for an incoming missile, the HML is required to make a dash on gravel roads with a missile payload to seek a site to harden and survive an air blast. Assistance was requested in three specific technical areas: 1) characterization of the variation of strength during the winter months for on- and off-road sites; 2) evaluation of hardening transition activities including the design of cutters to replace grouters located on the underside of the HML into frozen soil and gravel; and 3) on- and off-road mobility in snow covered terrain. These tasks were of particular importance because the HML was originally designed for non-cohesive soils and warmer temperatures of the desert southwest, not for the cohesive clays and clayey gravels of Montana that can have very high strengths when frozen, and not for snow cover that can make traction very difficult.

MP 3762

EVALUATION OF THE COLD REGIONS ASPECTS OF MOBILITY AND HARDENING OF THE MOBILE TEST BED AT MALMSTROM AIR FORCE BASE, GREAT FALLS, MONTANA. FINAL REPORT.

Blaisdell, G.L., Chamberlain, E.J., Mellor, M., *U.S. Army Cold Regions Research and Engineering Laboratory*, Aug. 1987, 46p. + append., 8 refs. 50-2725

SOIL TESTS, FROZEN GROUND MECHANICS, CLAY SOILS, SUBSTRATES, SOIL STRENGTH, SOIL STABILIZATION, HARDNESS TESTS, MILITARY EQUIPMENT, TRACTORS, STABILITY, COLD WEATHER PERFORMANCE, TRACTION, SOIL TRAFFICABILITY, FROZEN GROUND MECHANICS, UNITED STATES—MONTANA—GREAT FALLS

During the latter part of the winter season of 1986-87, an evaluation of the mobility and hardening capabilities of the Mobile Test Bed (MTB) was made at Malmstrom AFB, Great Falls, MT. The MTB is a pre-prototype model of the Hard Mobile Launcher (HML) being evaluated for deployment in the U.S. Air Force Small ICBM Program. The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) was contracted by the Ballistic Missile Office (BMO) to assist in the evaluation of the performance of this vehicle under winter and spring conditions. The HML is required to traffic gravel roads in order to seek a place to harden and survive an air blast. Assistance was requested in three specific technical areas: 1) on- and off-road mobility on seasonally varying terrain; 2) evaluation of hardening transition activities.

ties including the design of cutters to emplace grousers located on the underside of the HML into frozen soil and gravel, the performance of the cutters, and the tractive effort available to accomplish this task; and 3) characterizing and modeling the seasonally varying strength of on- and off-road terrain in support of the mobility and hardening transition activities. These tasks were of particular importance because the current test bed version of the HML was designed for noncohesive soils of the desert Southwest, whereas the soils in the current test area are dominated by clays and clayey gravels which have very high strengths when frozen and undergo large seasonal changes in strength.

MP 3763

USE OF GEOSYNTHETICS TO PREVENT WHITE PHOSPHORUS POISONING OF WATERFOWL IN EAGLE RIVER FLATS, ALASKA.

Henry, K.S., Collins, C.M., Racine, C.H., Geosynthetics '95 Conference, Nashville, TN, Feb. 21-23, 1995. Proceedings, Vol.2, St. Paul, Industrial Fabrics Association International, 1995, p.483-496, 13 refs.

50-2865

WATER POLLUTION, PONDS, ECOLOGY, BOTTOM SEDIMENT, SUSPENDED SEDIMENTS, EXPLOSIVES, ENVIRONMENTAL IMPACT, ENVIRONMENTAL PROTECTION, SYNTHETIC MATERIALS, GEOTEXTILES, FILTERS, LININGS, POROSITY, PERFORMANCE, UNITED STATES—ALASKA—EAGLE RIVER FLATS

Experiments were conducted to investigate the feasibility of using geosynthetics to keep waterfowl from eating white-phosphorus-contaminated pond sediments in an estuarine salt marsh. A laboratory study evaluated whether white phosphorus particles become suspended into overlying water because of 1) upward water flow through contaminated sediment capped (or not) with geotextile or 2) tapping of the top of the geotextile or sediment and then vigorously stirring the water to simulate waterfowl feeding and swimming. White phosphorus particles of a size that would be dangerous to waterfowl did not become suspended in the water column under any of the test conditions. A field study documented sedimentation and vegetation growth on three geotextiles and on an erosion control product placed on the bottom of salt marsh ponds. A means to vent gas formed in sediments through saturated material with pore diameters smaller than 3.4 mm is needed, as well as a way to anchor products in ponded areas subject to strong tidal action.

MP 3764

BREAKTHROUGH LOADS OF FLOATING ICE SHEETS: SMALL-SCALE TESTS WITH UREA MODEL ICE.

Sodhi, D.S., International Conference on Offshore Mechanics and Arctic Engineering (OMAE), 14th, Copenhagen, Denmark, June 18-22, 1995. Proceedings. Vol.4. Edited by W.A. Nixon, D.S. Sodhi, N.K. Sinha and F.T. Christensen, New York, American Society of Mechanical Engineers, 1995, p.21-27, 11 refs.

50-2939

ICE FLOES, ICE COVER STRENGTH, ICE SOLID INTERFACE, ICE LOADS, ICE DEFORMATION, ICE BREAKING, PENETRATION TESTS, ENVIRONMENTAL TESTS

At present, ice breakthrough load is estimated using empirical relations developed from the results of full-scale field experiments. In this paper, a theoretical formulation is presented to obtain an upper-bound estimate of the breakthrough load using the yield line method for plates. Small-scale experiments were conducted by vertically loading urea model ice in the basin at the CRREL laboratory to obtain the breakthrough loads for floating ice. The results of the following series of experiments are presented: (1) for beams with fixed ends, and (b) for floating ice sheets with fixed and free boundaries. The breakthrough loads measured in this study are presented with respect to ice thickness. These results are then compared with the breakthrough loads of freshwater floating ice sheets measured during full-scale and small-scale experiments.

MP 3765

PROCEEDINGS. VOLUME IV. ARCTIC/POLAR TECHNOLOGY.

International Conference on Offshore Mechanics and Arctic Engineering (OMAE), 14th, Copenhagen, Denmark, June 18-22, 1995, Nixon, W.A., ed, Sodhi, D.S., ed, Sinha, N.K., ed, Christensen, F.T., ed, New York, American Society of Mechanical Engineers, 1995, 289p., Refs. passim. For individual papers see 50-2935 through 50-2975.

50-2935

ICE SOLID INTERFACE, ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE DEFORMATION, ICE CRACKS, ICE BREAKING, ICE ACCRETION, OFFSHORE STRUCTURES, OFFSHORE DRILLING, ECONOMIC DEVELOPMENT

MP 3766

CHARACTERIZATION OF FROZEN GROUND STRENGTH AND SUPPORT FOR HARDENING TRANSITION AND MOBILITY TESTS FOR THE HARD MOBILE LAUNCHER.

Chamberlain, E.J., Janoo, V., Semperebon, J., Carbee, D., Durell, G., U.S. Army Cold Regions Research and Engineering Laboratory. Final draft report, July 1989, 31p. + append., 3 refs.

50-3042

MILITARY EQUIPMENT, MILITARY RESEARCH, SOIL TESTS, EXCAVATION, CLAY SOILS, FROZEN GROUND STRENGTH, FROZEN GROUND PHYSICS, SOIL TEMPERATURE, COMPRESSIVE PROPERTIES, COLD WEATHER TESTS, HARDNESS TESTS, BITUMINOUS CONCRETES, SNOW COVER EFFECT, FORECASTING

The purpose of this study was to obtain information on how soil strength affects the ability of the Hard Mobile Launcher (HML) to perform its hardening transition function in the Northern Tier of the United States. The authors characterized the variation of soil strength during the winter for 7 sites, temperature and moisture data on an hourly basis, strength to soil moisture and temperature conditions, soil strength in the upper 6 inches at each site on an hourly basis, and the percent of time that the strength exceeded certain levels. When coupled with data from hardening transition tests with the prototype HML, this data will allow the determination of the percent of time that the HML can perform its hardening transition function. The unconfined compressive strength in the upper 4 inches (the grouser height was reduced from 6 in. to 4 in. on the prototype HML) at 4 of the test sites exceeds 1200 psi more than 15% of the time during the winter. This strength level may be critical to the hardening transition task. Also presented are data collected in direct support of the hardening transition tests at Malmstrom Air Force Base. This data includes snow and soil conditions and temperatures. Lastly, the results of unconfined compressive strength tests on asphalt concrete samples are presented. This work was done in support of planned hardening transition tests on an asphalt concrete skid pad. (Auth. mod.)

MP 3767

PROCEEDINGS OF THE 52ND ANNUAL EASTERN SNOW CONFERENCE, TORONTO, ONTARIO, JUNE 7-8, 1995.

Eastern Snow Conference, Albert, M.R., ed, Taylor, S., ed, 1995, 263p., Refs. passim. For individual papers see 50-3105 through 50-3131.

50-3104

SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW HYDROLOGY, SNOWMELT, SNOW COVER EFFECT, SNOW AIR INTERFACE, SNOW HEAT FLUX, SNOW COMPOSITION

MP 3768

DISTRIBUTED SNOW PROCESS MODELING: AN IMAGE PROCESSING APPROACH.

Davis, R.E., McKenzie, J.C., Jordan, R.E., Eastern Snow Conference. Proceedings, 1995, 52nd, p.29-38, 14 refs.

50-3108

SNOW SURVEYS, SNOW COVER DISTRIBUTION, SNOW HYDROLOGY, SNOWMELT, SNOW HEAT FLUX, WEATHER FORECASTING, RUNOFF FORECASTING, TERRAIN IDENTIFICATION, SPACEBORNE PHOTOGRAPHY, COMPUTERIZED SIMULATION, IMAGE PROCESSING

This paper reports on an approach to spatially distribute a snow process model by segmenting images of land cover, terrain and snow properties. A small 1.7-ha study area with an existing database was selected for this preliminary evaluation. The methodology was carried out over a relatively flat valley bottom at Camp Grayling, MI. Meteorological measurements on two sides of the area showed only small differences, so uniform meteorological variables were assumed over the site. Initial snow cover conditions were reconstructed and distributed over the area using snow maps and sparse snow pit measurements. One-meter resolution terrain, soil, vegetation and snow type maps were individually processed into class maps. These layers were then combined to produce a segmented class map, where the attributes from the data layers were known for each class. A one-dimensional model of snow processes was run for each class; the results were then mapped back into images. Shallow snow conditions provided high sensitivity of ablation patterns to meteorological conditions over a 72-hour period. Model performance was assessed by comparing predicted and observed ablation patterns. Error in total snow-covered area was less than 9%. However, the location errors were greater (predicted snow where no snow was observed and observed snow where no snow was predicted). Extensive error analysis was not justified because of the lack of multiple point measurements of snow properties.

MP 3769

BIDIRECTIONAL REFLECTANCE MEASUREMENTS OF TWO SNOW TYPES.

Taylor, S., Koh, G., Davis, R.E., Fisk, D.J., Eastern Snow Conference. Proceedings, 1995, 52nd, p.79-84,

9 refs.

50-3113

SNOW SURVEYS, SNOW COVER STRUCTURE, SNOW MORPHOLOGY, SNOW SURFACE, SNOW DENSITY, SNOW HEAT FLUX, SNOW OPTICS, ALBEDO, RADIMOMETRY, RADAR ECHOES

Normalized reflectance measurements of snow were made at visible and near-infrared wavelengths. Measurements at 5 zenith and 14 azimuth angles were made to calculate the bidirectional reflectance distribution functions (BRDF) of different snow types. The snow density and grain size were obtained to relate the physical and spectral properties of the snow cover. The spectral measurements show significant anisotropy in the BRDF of the two snow types discussed in this paper. Implications of these results for energy budget calculations of snow covers and remote characterization of snow cover properties are discussed.

MP 3770

SCALING SNOWDRIFT DEVELOPMENT RATE.

Lever, J.H., Haehnel, R.B., Eastern Snow Conference. Proceedings, 1995, 52nd, p.85-94, 41 refs.

50-3114

SNOWDRIFTS, SNOW EROSION, WIND EROSION, SNOW AIR INTERFACE, SNOW LOADS, SNOW FENCES, WIND TUNNELS, ENVIRONMENTAL TESTS, MATHEMATICAL MODELS

For successful snowdrift modeling, measured drift shapes should be geometrically similar to full-scale ones and develop at rates that scale in a known manner. Consensus exists on most modeling methods and similitude requirements needed to meet these objectives. A notable exception is the manner to scale drift development rates. This paper presents the authors' rationale for rate scaling based on independent model and prototype mass-transport measurements, as originally proposed by Anno in 1984. They validate this approach by comparing the rate of drift development for a model Wyoming snow fence with corresponding field data. Anno's method yields excellent agreement, while alternatives differ substantially.

MP 3771

ACCURACY OF TRETYAKOV PRECIPITATION GAUGE: RESULT OF WMO INTERCOMPARISON.

Yang, D.Q., Bates, R.E., Pangburn, T., Eastern Snow Conference. Proceedings, 1995, 52nd, p.95-106, 36 refs.

50-3115

SNOWFALL, BLOWING SNOW, PRECIPITATION GAGES, SNOW FENCES, WIND FACTORS, WEATHER STATIONS, STATISTICAL ANALYSIS

From 1986 to 1993, the accuracy and performance of the Tretyakov gauge was evaluated during the WMO Solid Precipitation Measurement Intercomparison at 11 stations in Canada, USA, Russia, Germany, Finland, Romania and Croatia. The Intercomparison data for the Tretyakov gauge were compiled from measurements made at these WMO Intercomparison sites. These data represent a variety of climate, terrain and exposure. The effects of environmental factors, such as wind speed, wind direction, type of precipitation and temperature, on gauge catch were investigated. Wind speed was found to be the most important factor determining gauge catch and air temperature had a secondary effect, when precipitation was classified into snow, mixed and rain. The results of the analysis of gauge catch ratio vs. wind speed and temperature on a daily time step are presented for various types of precipitation. Independent checks of the correction equations against the DFR (Double Fence Intercomparison Reference) have been conducted at the 11 Intercomparison stations and a good agreement (difference less than 10%) has been obtained. The use of such adjustment procedures should significantly improve the accuracy and homogeneity of gauge-measured precipitation data over large regions of the former USSR and central Europe.

MP 3772

PRELIMINARY STUDY OF MELTING SNOW AND RIVER ICE BY DUSTING USING LEAF MULCH.

Haehnel, R.B., Clark, C.H., Eastern Snow Conference. Proceedings, 1995, 52nd, p.139-149, 15 refs.

50-3120

RIVER ICE, ICE CONTROL, ICE DETERIORATION, SNOW ICE INTERFACE, SNOW MELTING, ICE MELTING, ARTIFICIAL MELTING, DUSTING

Dusting ice with a dark material has been used on northern rivers to weaken river ice, with the objective of preventing ice jams during spring runoff. River sand, coal slag and fly ash have been commonly used to melt ice. However, introduction of these materials to rivers can adversely affect the fish habitat. The authors explored the use of leaf mulch as an alternative dusting material that can be used in place of sand, etc. This report summarizes the field work carried out by the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) during the springs of 1993 of 1994, studying the effectiveness of leaf mulch and other biodegradable dusting materials in comparison to previously used dusting materials. It was found that the leaf mulch is effective in lowering the albedo of the white ice surface from 0.5 to 0.2, which is comparable to the albedo of coal slag or sand on ice.

During the spring of 1994 leaf mulch was spread on the ice using a hydroseeder. It was possible to dust 8000 m² (2 acres) in about 20 minutes using the hydroseeder. Field tests showed that leaf mulch is effective at melting the snow cover on top of the ice. This allows the sunlight to start melting the dusted ice sooner than the undusted ice. Leaf mulch was as effective at melting the ice cover as sand and other materials.

MP 3773

RIVER ICE CONTROL AND FISH HABITAT RESTORATION: MUTUAL INTERESTS AND BENEFITS.

Lever, J.H., Nislow, K., *Eastern Snow Conference. Proceedings*, 1995, 52nd, p.151-158, 39 refs.

50-3121

RIVER ICE, ICE COVER EFFECT, ICE JAMS, ICE CONTROL, ICE BOOMS, HYDRAULIC STRUCTURES, FLOOD CONTROL, ECOLOGY, ENVIRONMENTAL PROTECTION To develop environmentally acceptable ice control measures for small rivers, researchers must screen alternatives for their impact on river ecosystems, including fish populations. Similarly, to develop structures to improve fish habitat in cold regions, one must understand how these structures alter ice regime and thence how the fish respond. Unfortunately, there is little information to determine how altering ice regime, for either ice control or habitat restoration, affects fish. This paper explores several areas of mutual interest to river engineers and ecologists. These interests begin with a need to quantify linkages between ice regime and ecological consequences. The authors also discuss the convergence of needs to control ice for the benefit of both aquatic and human communities and suggest specific topics for future research.

MP 3774

WINTER METHANE DYNAMICS BENEATH ICE AND IN SNOW IN A TEMPERATE POOR FEN.

Melloh, R.A., Crill, P.M., *Eastern Snow Conference. Proceedings*, 1995, 52nd, p.221-228, 23 refs.

50-3127

WETLANDS, PEAT, ICE COVER EFFECT, SOIL CHEMISTRY, SOIL AIR INTERFACE, SNOWFALL, SNOW COMPOSITION, SNOW COVER EFFECT, SNOW AIR INTERFACE, NUTRIENT CYCLE, UNITED STATES—NEW HAMPSHIRE Winter's influence on methane (CH₄) stored in pore water and emitted through snow was investigated in a temperate poor fen in New Hampshire over two winters (1993-94, 1994-95). CH₄ accumulated beneath ice layers (1 cm) deposited by freezing rain, resulting in snow pore air mixing ratios as high as 140 ppmv the first winter and 600 ppmv the second. An early winter snow crust of 300 kg/m³ caused no discontinuity in a linear mixing ratio profile and therefore was not observed to retard snowpack emissions. CH₄ concentration depth profiles in pore water steepen and concentrations increase by as much as 400 µM at the 10- and 20-cm depths as the ice cover forms. This suggests that the peat-ice cover plays an important role in CH₄ buildup in pore water by limiting transport of gases between the peat and the atmosphere. Pore water concentrations gradually decline through late winter. The seasonality of dissolved CH₄ in pore water over two winters and one summer shows an average annual amplitude of 1.3 g CH₄/m² (25- to 75-cm depth range), with a winter maximum of 4.7 g CH₄/m². Emissions during the winter with average snowfall accounted for a larger percentage (9.2% in 1993-94) of total annual emission than did the winter with below-average snowfall and warmer air temperature (2% in 1994-95). Emissions averaged 56 and 26 mg/m²/day during the first and second winter (Dec., Jan. and Feb.), respectively.

MP 3775

SNOW-INDUCED THERMAL VARIATIONS AROUND A SINGLE CONIFER TREE.

Hardy, J.P., Albert, M.R., *Eastern Snow Conference. Proceedings*, 1995, 52nd, p.239-247, 19 refs.

50-3129

FOREST LAND, FOREST CANOPY, VEGETATION FACTORS, INTERCEPTION, SNOW HYDROLOGY, SNOW HEAT FLUX, SNOW TEMPERATURE, SNOW COVER EFFECT, FROZEN GROUND TEMPERATURE, FROST PENETRATION

The influence of trees on the ground thermal regime is important to the overall winter energy exchange in a snow-covered, forested watershed. In this paper, spatial zones around a single conifer tree are defined and examined for their controls on the snow cover, snow/ground interface temperatures and frozen ground extent. A large white spruce (*Picea glauca*), approximately 18 m tall with a crown diameter of 7.5 m, and located in northern Vermont, was the subject of this study. The tree was instrumented with thermistors to measure the snow/ground interface temperature between the tree trunk and 6 m from the tree into undisturbed snow. Four distinct zones around the conifer are defined that affect snow distribution characteristics: adjacent to the trunk, the tree well, tree crown perimeter, and the unaffected area away from the tree. At the time of peak snow accumulation and during the ablation season, snow depth and density profiles were measured. The area beneath the canopy accumulated 34% of the snow accumulated in the undisturbed zone. By the end of the ablation season, the depth of snow under the canopy had decreased to 18%

of the undisturbed snow depth. Tree and branch characteristics of spruce in this temperate climate resulted in a different snow depth profile when compared to previous empirical relationships around a single conifer. Less snow beneath the canopy led to colder snow ground interface temperatures than measured in undisturbed snow. The depth of frozen ground in the different zones was modeled using a simple analytical solution that showed deeper frost penetration in the tree well than beneath the undisturbed snow.

MP 3776

EXCLUSION OF SODIUM CHLORIDE FROM ICE DURING FREEZING.

Cragin, J.H., *Eastern Snow Conference. Proceedings*, 1995, 52nd, p.259-262, 6 refs.

50-3131

SALT WATER, BRINES, ARTIFICIAL FREEZING, ICE FORMATION, SALT ICE, ICE SALINITY, ICE WATER INTERFACE, DESALTING

An apparatus was designed and built to freeze aqueous solutions directionally at a constant rate with a planar interface. Solutions of 1.65 per mill NaCl (28.2 mM) were then frozen with stirring (to prevent brine concentration at the ice/water boundary) at 2.5 mm/hr, a rate commensurate with that found in natural water systems. Samples were taken along the growth (time) axis and chemically analyzed to determine ion distribution coefficients, a measure of the efficiency of salt exclusion. Distribution coefficients were found to vary with salt concentration and ice crystal morphology.

MP 3777

ANTARCTIC COMMUTE: CRREL SEARCHES FOR SAFE LAND ROUTE TO SOUTH POLE.

Chalmers, P., *Engineer update*, Feb. 1996, 20(2), p.6-7.

50-3239

LOGISTICS, ROUTE SURVEYS, CREVASSE DETECTION, TRAVERSES, STATIONS, COLD WEATHER CONSTRUCTION, ANTARCTICA—AMUNDSEN-SCOTT STATION

As part of the U.S. National Science Foundation's (NSF) South Pole Redevelopment Project (SPRP), the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) is seeking a feasible overland route from McMurdo Station to Amundsen-Scott Station at the South Pole, 700 air miles away. The proposed new station will be of modular design on stilts to permit snow to blow beneath it instead of drifting. By the current air route at a cost of \$2/lb, the estimated 17 million pounds of cargo required for the rebuilding would cost at least \$34 million. It is estimated that an overland route could carry two and a half times the cargo at half the cost. The first part of the route must cross the Transantarctic Mountains. Glaciers mark the passes but are subject to severe crevasse hazards. A helicopter-borne pulsed radar with its operating frequency boosted from the normal 80-100 MHz to 500 MHz has been tested for crevasse detection. Flown at 30 knots and 20 feet above the surface, it can scan a 15-meter-wide swath of snow and ice to a depth of 20 meters.

MP 3778

UNITED STATES ARCTIC RESEARCH PLAN: BIENNIAL REVISION: 1996-2000.

Meyers, C.E., Haugh, J., Cate, D.W., *Arctic research of the United States*, Spring 1995, Vol.9, 68p.

50-3243

RESEARCH PROJECTS, OCEANOGRAPHY, METEOROLOGY, CLIMATOLOGY, NATURAL RESOURCES, ENVIRONMENTAL PROTECTION, ECOSYSTEMS, INTERNATIONAL COOPERATION, COST ANALYSIS

MP 3779

EFFECTS OF FIRE IN THE TAIGA ON THE ENVIRONMENT.

Lotspeich, F.B., Mueller, E.W., *Symposium on Fire in the Northern Environment*, Fairbanks, AK, Apr. 13-14, 1971. *Proceedings*. Edited by C.W. Slaughter et al, Portland, U.S. Department of Agriculture, 1971, p.45-50.

50-3244

FOREST FIRES, COUNTERMEASURES, SOLUTIONS, GEOCHEMISTRY, TAIGA, ECOSYSTEMS, WATER POLLUTION, ENVIRONMENTAL PROTECTION, ENVIRONMENTAL IMPACT, PERMAFROST PRESERVATION

MP 3780

CATLINE REHABILITATION AND RESTORATION.

Bolstad, R., *Symposium on Fire in the Northern Environment*, Fairbanks, AK, Apr. 13-14, 1971. *Proceedings*. Edited by C.W. Slaughter et al, Portland, U.S. Department of Agriculture, 1971, p.107-116.

50-3245

FOREST FIRES, ENVIRONMENTAL IMPACT, SOIL EROSION, SOIL STABILIZATION, LAND RECLAMATION, PERMAFROST PRESERVATION, EARTHWORK, DAMS, ENVIRONMENTAL PROTECTION

MP 3781

COUPLED VERTICAL AND HORIZONTAL GALLOPING—DISCUSSION.

Havard, D.G., Turan, Ö.F., Jones, K.F., *Journal of engineering mechanics*, Mar. 1993, 119(3), p.640-641, 4 refs. For pertinent paper see 46-3072.

50-3253

POWER LINE ICING, TRANSMISSION LINES, STABILITY, WIND FACTORS, ICE ACCRETION, ICE COVER EFFECT, OSCILLATIONS, DYNAMIC PROPERTIES

MP 3782

MECHANICAL BEHAVIOR OF FROZEN EARTH MATERIALS UNDER HIGH PRESSURE TRIAXIAL TEST CONDITIONS.

Chamberlain, E.J., Groves, C., Perham, R., U.S. Army Cold Regions Research and Engineering Laboratory. Technical report, Hanover, Mar. 1970, 24p. + appends., 9 refs. For another version see 27-1428.

50-3310

FROZEN GROUND MECHANICS, FROZEN GROUND COMPRESSION, PERMAFROST PHYSICS, SOIL TESTS, STRAIN TESTS, HIGH PRESSURE TESTS, UNFROZEN WATER CONTENT, SOIL COMPACTION, POROSITY, PHASE TRANSFORMATIONS, COMPRESSIVE PROPERTIES

The purpose of this study was to determine the mechanical properties of frozen earth material under high overburden pressures. Specifically of interest were Poisson's ratio and the shear modulus. The results are to be used to aid in the analysis of disturbances originating at depth in areas of deep continuous permafrost. Triaxial compression tests to 40 ksi confining pressure were performed at -10°C on two different types of frozen earth materials: ice-saturated, fine-grained, poorly-graded sand and ice-saturated well-graded silt. The materials were selected to represent wide variations in natural conditions. They were prepared and reconstituted in the laboratory to form nearly homogeneous test samples.

MP 3783

MATHEMATICAL MODEL TO CORRELATE FROST HEAVE OF PAVEMENTS WITH LABORATORY PREDICTIONS. FINAL REPORT.

Berg, R.L., Guymon, G.L., Johnson, T.C., U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, Apr. 1979, 120p., Refs. p.79-85. For another version see 34-3200.

50-3333

PAVEMENTS, DEFORMATION, FROST HEAVE, FROST ACTION, PHASE TRANSFORMATIONS, SOIL WATER MIGRATION, SUBGRADES, PAVEMENT BASES, FROZEN GROUND MECHANICS, FROST PENETRATION, MATHEMATICAL MODELS, DESIGN CRITERIA

A mathematical model of coupled heat and moisture flow in soils has been developed. The model includes algorithms for phase change of soil moisture and frost heave, and several types of boundary and initial conditions are permitted. The finite element method of weighted residuals (Galerkin procedure) was chosen to simulate the spatial regime and the Crank-Nicolson method was used for the time domain portion of the model. To facilitate evaluation of the model, the heat and moisture fluxes were essentially "decoupled"; moisture flux was then simulated accurately, as were heat flux and frost penetration. The coupled model was used to simulate frost penetration and frost heave in a laboratory test. Comparison of the simulated and experimental data illustrates the importance of unsaturated hydraulic conductivity. It is one parameter which is difficult to measure and for which only a few laboratory test results are available. Therefore, unsaturated hydraulic conductivities calculated in the computer model may be a significant source of error in calculations of frost heave. The algorithm incorporating effects of surcharge and overburden was inconclusively evaluated. Time-dependent frost penetration and frost heave in laboratory specimens were closely simulated with the model.

MP 3784

FUNDAMENTALS OF ICE LENS FORMATION.

Takagi, S., *National Heat Transfer Conference*, 15th, San Francisco, CA, Aug. 10-13, 1975, 25p., 27 refs. For another version see 33-2083.

50-3390

SOIL FREEZING, FROZEN GROUND THERMODYNAMICS, GEOCRYOLOGY, ICE WATER INTERFACE, PHASE TRANSFORMATIONS, ICE FORMATION, FREEZING FRONT, ICE LENSES, ICE PRESSURE, FROST HEAVE, SOIL WATER MIGRATION, MATHEMATICAL MODELS A new concept of the freezing of water, called "segregation freezing", is proposed to explain the creation of the suction force that draws pore water up to the interface of a growing ice lens. The temperature of segregation freezing is shown to be lower than that of normal freezing (in-situ freezing). This difference determines the pressure that the ice lens exerts while growing and carrying the overlying weight. On the assumption that the soil structure is rigid, equations governing the simultaneous flow of heat and water are formulated, and solved for the limit of time $t \rightarrow 0$ with a combination of analytical and numerical methods. Numerical

computation of the solution yields a result that is reasonable compared with experience in laboratory and in the field.

**MP 3785
SEDIMENTARY AND HYDROLOGIC PROCESSES WITHIN MODERN TERRESTRIAL VALLEY GLACIERS.**

Lawson, D.E., Modern glacial environments: processes, dynamics and sediments. Edited by J. Menzies, Oxford, England, Butterworth-Heinemann Ltd., 1995, p.337-363, Numerous refs. p.507-590. 50-3591

ALPINE GLACIATION, MOUNTAIN GLACIERS, GLACIAL GEOLOGY, GLACIAL EROSION, GLACIAL DEPOSITS, GLACIAL HYDROLOGY, MORAINES, OUTWASH, SEDIMENT TRANSPORT

**MP 3786
MOISTURE-BASED MODEL FOR CALCULATING DAILY CHANGES IN SEASONAL SOIL FROST DEPTH.**

Ryerson, C.C., *Publications in climatology*, 1979, 32(2), 115p., Refs. p.61-69. Includes a 3.5" high-density diskette. 50-3713

SOIL FREEZING, FROZEN GROUND THERMODYNAMICS, FROST PENETRATION, FROST FORECASTING, SEASONAL FREEZE THAW, COMPUTER PROGRAMS, MATHEMATICAL MODELS, STATISTICAL ANALYSIS

**MP 3787
EFFECTS OF ICE-PROXIMAL SEDIMENT DYNAMICS ON THE STABILITY OF MUIR GLACIER, GLACIER BAY, ALASKA.**

Hunter, L.E., Powell, R.D., Glacier Bay Science Symposium, 3rd, Gustavus, AK, Sep. 15-18, 1993. Proceedings. Edited by D.R. Engstrom, Anchorage, AK, U.S. Department of the Interior, National Park Service, 1995, p.29-37, 19 refs. 50-3735

GLACIAL GEOLOGY, GLACIAL DEPOSITS, GLACIER OSCILLATION, GLACIER FLOW, CALVING, MORAINES, OUTWASH, MARINE GEOLOGY, MARINE DEPOSITS, BOTTOM SEDIMENT, SEDIMENT TRANSPORT, UNITED STATES—ALASKA—GLACIER BAY

Recent studies have shown that water depth at tidewater termini affects calving rates, and therefore glacier mass balance and terminus stability. If sediment dynamics at tidewater termini influence grounding-line water depth, they may also moderate glacier dynamics. Grounding-line water depths are governed by glacial and marine processes that interact during the formation of moraine bank depocenters. Moraine bands can fluctuate tens of meters in height within a few weeks. Such rapid changes are important when interpreting glacier behavior where terminus fluctuations may represent a dynamic response to sedimentary processes that are independent of climatic forcing. Sedimentologic investigations in upper Muir Inlet have focused on quantitatively assessing sediment budgets in the ice-proximal environment. Monitoring of Muir Glacier moraine bank has included repeated bathymetric mapping, sediment trap studies, bottom grab sampling, and glacier and iceberg sampling. These investigations provide detailed information on process dynamics and sediment budgets in order to determine the complex relationships between ice-proximal marine processes and glacier response. These relationships must be understood to interpret recent changes in the dynamics of Muir Glacier, where a century of retreat has been succeeded by quasi-stability as calving rates declined in response to rapid grounding-line deposition.

**MP 3788
CLIMATIC CONTROLS ON GLACIER MASS BALANCE IN GLACIER BAY NATIONAL PARK AND PRESERVE, ALASKA.**

Hunter, L.E., Powell, R.D., Glacier Bay Science Symposium, 3rd, Gustavus, AK, Sep. 15-18, 1993. Proceedings. Edited by D.R. Engstrom, Anchorage, AK, U.S. Department of the Interior, National Park Service, 1995, p.46-54, 22 refs. 50-3737

GLACIER SURVEYS, GLACIER OSCILLATION, GLACIER MASS BALANCE, GLACIER FLOW, GLACIAL METEOROLOGY, GLACIAL DEPOSITS, MORAINES, CALVING, SNOW LINE, CLIMATIC FACTORS, UNITED STATES—ALASKA—GLACIER BAY NATIONAL PARK

The importance of sediment dynamics on controlling the behavior of tidewater termini is becoming clear. However, climatic forcing on glaciers in Glacier Bay National Park and Preserve needs to be addressed to evaluate its relative importance. Little climatologic data exist for the region, so a preliminary assessment of climate forcing has been performed using data collected by the Icefield Ranges Research Project (IRRP), meteorologic observations from near sea level weather stations, and a reconnaissance mass balance study using snowlines determined from aerial photographs of Glacier Bay. The emphasis is on the climatic regimes that influence glaciers flowing into Tarr and Muir

Inlets. Precipitation in Glacier Bay is introduced directly from the Gulf of Alaska. Heavy precipitation on the coastal flanks of the Fairweather Range and a precipitation shadow extending across Glacier Bay and the Takshinsha Mountains are expected; but IRRP observations, local glacier mass balance investigations, and regional wind patterns indicate that this concept is oversimplified. High peaks along the crest of the Fairweather Range are an effective barrier to storms moving NE from the Gulf of Alaska that cause storms to be deflected and enter Glacier Bay from the south. Asynchronous response of glacier behavior to climatic forcing observed by meteorologic trends and reconnaissance glacier mass balance investigations indicate that tidewater termini in Glacier Bay are insensitive to climatic forcing. Moraine bank sediment dynamics at Grand Pacific and Muir Glaciers appear to modulate calving speeds and terminus behavior by controlling grounding-line water depth, which at least over short periods of time is more important than climatic forcing.

**MP 3789
DESCRIPTION OF AN APPROACH TO VALIDATION.**

Welsh, J.P., Koenig, G.G., Ground Target Modeling and Validation Conference, 6th, Houghton, MI, Aug. 1995. Proceedings. Vol.1, Houghton, Michigan Technological University, 1995, p.62-76, 2 refs. 50-3754

TERRAIN IDENTIFICATION, INFRARED RECONNAISSANCE, INFRARED PHOTOGRAPHY, ENVIRONMENT SIMULATION, MILITARY RESEARCH, MILITARY EQUIPMENT, MILITARY OPERATION, IMAGE PROCESSING, STATISTICAL ANALYSIS

Statistical inference and functional techniques have been used to validate a scene generation capability. This paper discusses the statistical inference approach. The statistical inference techniques have followed a stratified random block experimental design for comparison of model generated synthetic scenes to measured images. A validation approach has been used that incorporates: 1. formal experimental design (including random sampling procedures); 2. comprehensive data collection methods (including quality control and calibration); 3. physics formulations as energy balance models; and 4. statistical inference analysis and validation procedures. The scene generation capability produces synthetic infrared scenes that simulate a broad range of environment conditions. This capability can be used to generate scenes for the broad range of environment conditions and variety of targets needed to evaluate and predict system performance.

**MP 3790
SMART WEAPONS OPERABILITY ENHANCEMENT SYNTHETIC SCENE GENERATION PROCESS.**

Koenig, G.G., Welsh, J.P., Wilson, J., *SPIE—The International Society for Optical Engineering. Proceedings*, 1995, Vol.2469, Targets and backgrounds: characterization and representation, Orlando, FL, Apr. 17-19, 1995. Edited by W.R. Watkins and D. Clement, p.254-265, 9 refs. 50-3755

TERRAIN IDENTIFICATION, INFRARED PHOTOGRAPHY, INFRARED RECONNAISSANCE, ENVIRONMENT SIMULATION, COMPUTERIZED SIMULATION, IMAGE PROCESSING, MILITARY EQUIPMENT, MILITARY OPERATION, MILITARY RESEARCH

The Smart Weapons Operability Enhancement (SWOE) program has developed a synthetic scene generation process that incorporates formal experimental design, random sampling procedures, data collection methods, physics models, and numerically repeatable validation procedures. The SWOE synthetic scene generation procedure uses an assemblage of measurements, static and dynamic information databases, thermal and radiance models, and rendering techniques to simulate a wide range of environmental conditions. The models provide a spatial and spectral agility that permits the simulation of a wide range of sensor systems for varied environmental conditions. Comprehensive validation efforts have been conducted for two locations: Grayling, MI, and Yuma, AZ, and for two spectral bands: shortwave (3-5 µm) and longwave (8-12 µm) IR. The intended use of the validated SWOE Process is synthetic battlefield scene generation. The users of the SWOE Process are the smart weapon system designers, developers, testers and evaluators, including developers of automatic target recognition algorithms and techniques.

**MP 3791
HIGH SPATIAL AND TEMPORAL RESOLUTION DATABASE FOR SYNTHETIC SCENE GENERATION AND VALIDATION.**

Bleiweiss, M.P., Cassidy, T., Scott, F., Koenig, G.G., Welsh, J.P., Battlefield Atmospherics Conference, White Sands Missile Range, NM, 1995, White Sands Missile Range, U.S. Army Research Laboratory, Battlefield Environment Directorate, 10p., 3 refs. 50-3756

TERRAIN IDENTIFICATION, INFRARED PHOTOGRAPHY, INFRARED RECONNAISSANCE, ENVIRONMENT SIMULATION, COMPUTERIZED SIMULATION, MILITARY OPERATION, MILITARY EQUIPMENT, MILITARY

RESEARCH, IMAGE PROCESSING

The overall objective of the Smart Weapons Operability Enhancement (SWOE) Joint Test and Evaluation (JT&E) program sponsored by the Office of the Secretary of Defense is the enhancement of smart weapons performance through an effective application of knowledge of the environment. Specifically, the two objectives of the SWOE JT&E effort are to 1) validate the SWOE scene generation process and 2) collect a selected data set for use by the DoD community. This presentation provides an overview of the high spatial and temporal resolution environmental and imagery database collected during three SWOE field programs. These field programs were conducted during the summer-fall and winter-spring transition periods at Grayling, MI and the winter-spring transition at Yuma, AZ. During the field programs, an extensive set of environmental parameters (e.g., air and soil temperature, solar and infrared fluxes, etc.) were collected at several locations over a fairly small test area. These parameters are required for synthetic scene generation and model evaluation, and have been used to investigate the "within" and "between" environmental variability. In addition to the collection of the environmental parameters, extensive infrared (IR) and millimeter wave (MMW) imagery were collected utilizing ground-based and airborne sensor systems. The IR imagery has been utilized in the validation of the SWOE generated synthetic scenes and to investigate the scene-to-scene and sensor-to-sensor thermal IR variability.

**MP 3792
FLOATING SLABS FOR UNHEATED BUILDINGS.**

Crory, F.E., *New England builder*, Mar. 1987, 5(6), p.27-29. 50-3757

FOUNDATIONS, CONCRETE SLABS, GRAVEL, SUBGRADE SOILS, FROST RESISTANCE, FROST HEAVE, FROST PENETRATION, FROST PROTECTION, COLD WEATHER CONSTRUCTION

**MP 3793
ROLE OF INDUSTRIES AND ENVIRONMENTAL EFFECTS ON CORROSION CONTROL IN THE NORTH.**

Dutta, P.K., Controlling Corrosion in the Northern Latitudes, Anchorage, AK, Feb. 19-21, 1996. Conference proceedings, Houston, TX, National Association of Corrosion Engineers (NACE), 1996, p.405-413, 7 refs. 50-3760

POLAR ATMOSPHERES, AIR POLLUTION, WATER POLLUTION, ECONOMIC DEVELOPMENT, ENVIRONMENTAL IMPACT, HUMAN FACTORS, CORROSION, COLD WEATHER CONSTRUCTION, WEATHERPROOFING

The salt-laden atmosphere, the use of de-icing salt, a higher level of oxygen concentration in cold water, and sulfurous pollution from industries are several factors among many that exacerbate the corrosion problems of the Northern countries. Human activities in the Arctic and sub-Arctic areas of the North, especially the tendency toward increasing the extraction of hydrocarbon raw materials, is accompanied by increasing use of metallic components in human habitats, production and processing plants, transportation systems, and other infrastructure. These human activities produce corrosive pollutants that, after being released in the air and water, attack metallic structures. This paper discusses such corrosion problems in the North and the role of human factors, which have intensified the problem.

**MP 3794
JET-CUTTING AS AN ICE-BREAKING AID. PRELIMINARY REPORT ON FIELD TESTS FOR U.S. COAST GUARD.**

Mellor, M., Gagnon, F., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Apr. 1973, 16p., 4 refs. 50-3762

LAKE ICE, ICE CUTTING, ICE BREAKING, HYDRAULIC JETS, PENETRATION TESTS

**MP 3795
STUDIES IN APPLIED GLACIOLOGY, ANTARCTICA, 1961-1962.**

Mellor, M., Morelli, P., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, July 1962, 22p. + figs. 50-3805

STATIONS, UNDERSNOW FACILITIES, SNOW TUNNELS, SNOW LOADS, SNOW STRENGTH, SNOW (CONSTRUCTION MATERIAL), ANTARCTICA—BYRD STATION

During the antarctic summer of 1961-62 a CRREL group carried out a program of applied snow studies at New Byrd Station and at the South Pole. In the undersnow complex of New Byrd Station repeated surveys were made, and equipment for recording deformation and temperature was installed at a number of places. Foundation tests and confined compressive creep tests were conducted at both Byrd and South Pole, and some experiments on the reinforcement of cast snow (Peter snow) were made. The general aims of the project were to monitor deformation and temperature

change in the undersnow camp for the benefit of the operators, to provide data for the rational design of future ice cap stations, and to extend the range of information on snow properties in the antarctic environment. Since significant deformations in the undersnow complex at New Byrd will take one or two years to develop, this report is confined to a description of the tasks accomplished together with a preliminary data presentation and brief discussion.

MP 3796

EFFECTS OF INDIVIDUAL RIDGING EVENTS ON THE ICE THICKNESS DISTRIBUTION IN THE ARCTIC ICE PACK.

Hopkins, M.A., *Cold regions science and technology*, Jan. 1996, 24(1), p.75-82, 4 refs.

50-3828

SEA ICE, ICE MECHANICS, ICE DEFORMATION, PRESSURE RIDGES, FLEXURAL STRENGTH, ICE COVER THICKNESS, DISTRIBUTION, VARIATIONS, CLASSIFICATIONS, MATHEMATICAL MODELS, SIMULATION The functional relationship between the redistribution of ice thicknesses and deformation is an important component in basin scale models of the arctic ice pack. A description of the way in which ice thickens in a single pressure ridge is basic to an understanding of the redistribution over a large area of the pack containing many ridges. In this work the pressure ridging process is modeled using a two-dimensional particle simulation technique. Blocks are broken from an intact sheet of relatively thin lead ice driven against a thick, multi-year floe at a constant speed. The blocks of ice rubble accumulate to form the ridge sail and keel. A series of numerical experiments are performed with the model to determine the change in the ice thickness distribution in an area encompassing the ridge as a function of the volume of ridged lead ice.

MP 3797

SYNTHETIC SCENE GENERATION PROCESS FOR SMART WEAPONS.

Welsh, J.P., Link, L.E., Jr., *Army RD&A*, July-Aug. 1995, p.33-36.

50-3834

TERRAIN IDENTIFICATION, INFRARED PHOTOGRAPHY, INFRARED RECONNAISSANCE, ENVIRONMENT SIMULATION, COMPUTERIZED SIMULATION, IMAGE PROCESSING, MILITARY EQUIPMENT, MILITARY OPERATION, MILITARY RESEARCH

MP 3798

ON THE STRUCTURE OF PRESSURED SEA ICE.

Kovacs, A., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Sep. 1970, 57p., 15 refs.

50-3835

ICE FLOES, ICE PRESSURE, ICE DEFORMATION, PRESSURE RIDGES, ICE STRUCTURE, ICE COVER THICKNESS

MP 3799

DATASETS OF THE SCINTILLATION EXPERIMENT AT SEVILLETA, NEW MEXICO.

Otto, W.D., et al, *U.S. National Oceanic and Atmospheric Administration. Environmental Research Laboratories. Environmental Technology Laboratory. NOAA technical memorandum*, Feb. 1996, ERL ETL-261, 42p., 8 refs.

50-3849

SOIL AIR INTERFACE, HEAT FLUX, ATMOSPHERIC BOUNDARY LAYER, TURBULENCE, ATMOSPHERIC ATTENUATION, SCINTILLATION

The datasets from three optical scintillometers and a millimeter-wave instrument are discussed. The quantities of the refractive-index structure parameter C_n^2 , and the inner scale l_0 , which were obtained from atmospheric scintillation along with their derived fluxes, constitute these datasets. The datasets' structure and the overall data processing are described.

MP 3800

FLUXES OF MOMENTUM AND HEAT MEASURED AT SEVILLETA, NEW MEXICO.

Hill, R.J., et al, *U.S. National Oceanic and Atmospheric Administration. Environmental Research Laboratories. Environmental Technology Laboratory. NOAA technical memorandum*, Feb. 1996, ERL ETL-260, 46p., 10 refs.

50-3850

SOIL AIR INTERFACE, HEAT FLUX, ATMOSPHERIC BOUNDARY LAYER, TURBULENCE EXCHANGE, ATMOSPHERIC DENSITY, ATMOSPHERIC ATTENUATION, SCINTILLATION

The flux of sensible heat between the surface and the atmosphere was determined from a variety of different instruments and methods. These instruments were a Bowen ratio station, a three-axis sonic anemometer-thermometer, a single-axis sonic anemometer with a thermocouple, and scintillometers. The methods

employed were, respectively, energy balance, eddy correlation, and indirect dissipation. Comparison of the resulting sensible heat fluxes shows that they are in good agreement. Momentum flux is expressed in terms of the friction velocity and was obtained from several of the instruments by different methods. Friction velocity was obtained using eddy correlation of the three-axis sonic anemometer-thermometer data. The surface roughness was obtained from this data by application of Monin-Obukhov similarity theory. Using this roughness length, friction velocity was obtained from wind speed and heat flux measured at the Bowen station by application of Monin-Obukhov similarity. Friction velocity was also obtained from the scintillometer data using the indirect dissipation method, which is an application of Monin-Obukhov similarity. The scintillometer's friction velocity disagrees with the friction velocities from the sonic anemometer-thermometer and the Bowen station. This disagreement is shown to depend on atmospheric surface-layer stability. Also, scatter in the derived roughness length depends on the same stability ranges. Since there is no known reason for instrument malfunction to depend on stability, the data suggest that the accepted Monin-Obukhov similarity relationships are inaccurate for the experiment site; this might be caused by the inhomogeneity of the surface. However, the required deviation from standard Monin-Obukhov formulas seems to be too large to be plausible. Therefore, an unprecedented malfunction of the scintillometer is suspected.

MP 3801

SEA ICE DATA REPORT.

Kovacs, A., Kalafut, J., U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, June 1970, 9p. + append., 6 refs.

50-3854

SEA ICE, ICE COVER STRENGTH, ICE MECHANICS, ICE CORES, PENETRATION TESTS, IMPACT TESTS, PENETROMETERS, ICE SOLID INTERFACE, POROSITY, STATISTICAL ANALYSIS, TENSILE PROPERTIES, MECHANICAL PROPERTIES

From Feb. 18 to Mar. 18, 1970 the U.S. Coast Guard icebreaker *Northwind* (WAGB 282) was assigned for operations in the Bering and Chukchi Seas to support research programs by USACRREL (pressure ridge morphology investigations) and Sandia Laboratory (sea ice penetrometer study) and to undertake a transportation feasibility analysis, i.e. a northing penetration into the Chukchi Sea. The Sandia study consisted of determining the feasibility of measuring the thickness and strength of sea ice using instrumented, telemetric, airdropped penetrometers. In support of this study, CRREL obtained data characteristic of the ice penetrated by the instrumented projectile. These data include the measured temperature, salinity and strength of the ice with depth and the brine volume computed from temperature and salinity determinations. In addition, ice density vs. depth was obtained at several sites.

MP 3802

USING SOLAR ENERGY AT THE SOUTH POLE: PHOTOVOLTAIC ELECTRICITY AND SOLAR HEATING.

Wills, R.H., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Dec. 1988, 42p., 16 refs.

50-3880

ELECTRIC POWER, SOLAR RADIATION, HEATING, HEAT SOURCES, FUELS, COST ANALYSIS, ANTARCTICA—AMUNDSEN-SCOTT STATION

NSF (National Science Foundation) spends about \$1 million each year as of 1988 in fuel for electricity generation at the Amundsen-Scott Station. This could rise to \$1.3 million in the near future with the installation of new generators and the building of a new summer camp. The high cost is mainly due to fuel transport cost from McMurdo to the Pole. The cost of diesel fuel at the Pole is about \$8/gallon. The equivalent cost of electricity is 80¢/kw-h. At South Pole in summer, with 24 hours of sunshine each day, little cloud, clear air and a very reflective snow surface, an average of 1200 Watts/m² (110 W/t²) of solar energy is available for five months of the year. Summer is also the time of peak electric and heating demands. Direct electricity generation using photovoltaic cells is a practical way of reducing fuel consumption. A system costing \$1.4 million could generate an average of 180 kW over five months of the summer at less than 16¢/kWh and reduce fuel costs by \$330,000/y. A photovoltaic power system should operate for more than 20 years with no more than routine maintenance. It could also provide a prominent platform for U.S. renewable energy usage. Direct solar heating can be used at the Pole together with conventional oil-fired furnaces to reduce summer heating fuel use by 80% while still maintaining reliable heat and comfort levels. For example, the cost of heating a new summer camp building could be reduced from \$21,000 to \$4,000/16 week summer season using a solar heating system costing between \$20,000 and \$50,000, depending on the type of collectors used. (Auth. mod.)

MP 3803

U.S. ARMY RESEARCH CAMPS IN NORTH-WEST GREENLAND.

Tobiasson, W., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory,

[1968], 5p.

50-3882

STATIONS, MILITARY FACILITIES, EXPEDITIONS, RESEARCH PROJECTS, COLD WEATHER OPERATION, COLD WEATHER CONSTRUCTION, GREENLAND

MP 3804

EVALUATION OF ICE MANAGEMENT PROBLEMS ASSOCIATED WITH OPERATION OF A MECHANICAL ICE CUTTER ON THE MISSISSIPPI RIVER.

Ashton, G.D., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Dec. 1973, 43p. + append., 29 refs. For another version see 32-2600.

50-3954

RIVER ICE, ICE CONTROL, ICE CUTTING, ICE BREAKING, ICE NAVIGATION

MP 3805

MEASURING WIND SPEED IN FREEZING RAIN.

Claffey, K.J., Ryerson, C.C., Annual Mount Washington Observatory Symposium, 4th, North Conway, NH, June 23-24, 1995. Focus 2000: wind, ice, and fog, North Conway, NH, Mount Washington Observatory, 1996, p.9-16, 3 refs.

50-4029

ICE STORMS, ICE ACCRETION, WIND VELOCITY, ANEMOMETERS, METEOROLOGICAL INSTRUMENTS, WEATHER STATIONS, COLD WEATHER TESTS

An important factor contributing to ice accretion on structures during freezing rain is wind speed. Currently, most National Weather Service anemometers are not heated; therefore, reported wind speed during glaze storms may be compromised by a change in the aerodynamics of the anemometer caused by accreted ice. The Cold Regions Research and Engineering Laboratory (CRREL) tests instruments to determine their ability to make meteorological measurements in freezing rain. As part of these tests the authors deployed three anemometers: two heated and one unheated. The unheated instrument is a helioid anemometer, a standard instrument used at many Army research sites, made by R.M. Young. The heated units, made by Hydro-Tech and Rosemount, use, respectively, a modified cup design and pressure transducers to sense wind speed. In this report the authors describe the operating characteristics of the three anemometers in non-icing and icing conditions. During the test period, Oct. 1993 through May 1994, only two minor freezing rain storms occurred. Both of the heated anemometers stayed ice free, and the unheated Young anemometer iced moderately. The wind speeds reported by the three anemometers during these storms are compared and related to the icing that occurred on the unheated Young anemometer. Even though the Young anemometer was covered with ice during freezing rain, its 15-minute average wind speed measurements compared well with those of the heated Rosemount anemometer.

MP 3806

ROTATING MULTICYLINDER.

Jones, K.F., Koh, G., Annual Mount Washington Observatory Symposium, 4th, North Conway, NH, June 23-24, 1995. Focus 2000: wind, ice, and fog, North Conway, NH, Mount Washington Observatory, 1996, p.35-43, 9 refs.

50-4032

ICE ACCRETION, ICE FORECASTING, SUPERCOOLED CLOUDS, CLOUD DROPLETS, UNFROZEN WATER CONTENT, PARTICLE SIZE DISTRIBUTION, METEOROLOGICAL INSTRUMENTS

The rotating multicylinder method is used to measure the liquid water content and median volume diameter of droplets in sub-freezing clouds. This method takes advantage of the variation in the collision efficiency of cloud droplets with cylinders of different diameters. The multicylinder method was originated by Irving Langmuir in the early 1940s at the Mt. Washington Observatory, and multicylinder measurements are still made at the Observatory. This method of determining the liquid water content and median volume droplet diameter is labor intensive and time consuming. Its use is limited to 1) air temperatures low enough that the cloud droplets freeze on impact, and 2) combinations of wind speed and droplet size that result in measurable ice accretion on at least two cylinders. On the other hand, the multicylinder is inexpensive, virtually unbreakable and immune to RF noise. Since 1992, the authors have made multicylinder measurements alongside other instruments designed to measure cloud parameters in the severe weather the summit of Mt. Washington experiences. These comparisons are presented and discussed.

MP 3807

EFFICACY OF ICE DETECTOR HOARFROST OBSERVATIONS.

Ryerson, C.C., Claffey, K.J., Annual Mount Washington Observatory Symposium, 4th, North Conway, NH, June 23-24, 1995. Focus 2000: wind, ice, and fog, North Conway, NH, Mount Washington Observa-

tory, 1996, p.45-55, 8 refs.

50-4033

HOARFROST, ICE ACCRETION, ICE DETECTION, ICE FORECASTING, FROST FORECASTING, ICE STORMS, WEATHER FORECASTING, METEOROLOGICAL INSTRUMENTS

Nocturnal hoarfrost forms in calm, cloudless, subfreezing weather when surfaces radiatively cool to the frost point. Frost is sensitive to the orientation of surfaces to the sky, and to the thermal properties of those surfaces. A Rosemount ice detector, developed for the National Weather Service Automated Surface Observation System (ASOS) and commercial use, is designed to detect freezing rain but also responds to frost deposition. The purpose of this study is to examine the ability of the ice detector to predict frost formation on other surfaces. Frost accretion measurements are made at CRREL on aluminum and glass plates oriented to the zenith, and 45° and 90° to the zenith. They are weighed during frost events to determine the mass of ice deposited on each. There are significant differences between the time of initial frost formation on plates, depending upon orientation, and on the ice detector probe. Frost typically forms on plates of all orientations about 5-6 hours before the probe begins to frost. The reason is thought to be that the probe is exposed to the radiatively warmer horizon, it is warmed by circulating air and an internal diagnostic current, and it has a lower emissivity than the plates. It thus frosts later, and less intensely, than any other surface. The ice detector does not provide an "early warning" of frost accretion because it frosts after other objects, if at all. It represents frost formation on vertical objects, such as windows, more reliably than on horizontal surfaces, such as aircraft wings and bridge pavements. The ice detector responds only to those more severe frost events on surfaces that are generally of least interest.

MP 3808

SCATTERING FROM A METALLIC OBJECT EMBEDDED NEAR THE RANDOMLY ROUGH SURFACE OF A LOSSY DIELECTRIC.

O'Neill, K., Lusky, R.F., Jr., Paulsen, K.D., *IEEE transactions on geoscience and remote sensing*, Mar. 1996, 34(2), p.367-376, 19 refs.

50-4038

SUBSURFACE INVESTIGATIONS, ELECTROMAGNETIC PROSPECTING, RADAR ECHOES, IMAGE PROCESSING, COMPUTERIZED SIMULATION, MATHEMATICAL MODELS

Two-dimensional electromagnetic scattering from a perfectly conducting target embedded near the randomly rough surface of an isotropic lossy dielectric is investigated. The randomly rough surface is illuminated by a finite width beam from an antenna in the free space above the surface, with off-normal incidence. Standard integral equation methods are applied and include all subsurface interactions between the object and rough surface. For a chosen embedded target, Monte Carlo simulations are performed for a selection of ensembles of rough surface types intended to be suggestive of natural ground. Far-field scattering coefficient distributions and corresponding synthetic images suggest when the buried object should be discernible. Sensitivities are explored in terms of surface type, polarization of the incident field, depth and orientation of target, soil characteristics, incidence angle, and beam width. Many of the scattering features identified should also apply in 3-D.

MP 3809

BUBBLERS FOR ICE MELTING.

Ashton, G.D., Handbook of fluid dynamics and fluid machinery. Vol.3. Applications of fluid dynamics., New York, John Wiley & Sons, Inc., 1996, p.1970-1989, Refs. passim.

50-4182

BUBBLING, ICE CONTROL, ARTIFICIAL MELTING, ICE MELTING, ICE WATER INTERFACE, HYDRAULIC JETS, COMPRESSORS

MP 3810

REPORT OF THE ANTARCTIC TRAVERSE WORKSHOP, 2-4 MAY 1994, WASHINGTON, DC.

Blaisdell, G.L., Symposium on Antarctic Logistics and Operations, 6th, Rome, Italy, 1994. Proceedings, [1994], p.321-322.

50-4283

MEETINGS, TRAVERSES, TRANSPORTATION, SNOW VEHICLES

This workshop is the third in a series of vehicle-related specialty meetings addressing the unique needs of national antarctic programs. Sponsored by the US National Science Foundation Office of Polar Programs, it addressed long antarctic traverses. The primary focus was on heavy hauling oversnow rather than short, light traverses with a purely scientific purpose. Because of the major concern for crevasses by all who traverse the antarctic terrain, this workshop included several scientific experts who addressed modern methods for selecting safe and efficient traverse routes and the use of impulse radar for detecting bridged sub-surface voids. It became readily apparent throughout the workshop that, despite a marked advance in such areas as antarctic clothing, berthing, food, and equipment, we today have no better record of avoiding crevasses on traverse than did Hillary and

Fuchs in the mid 1950s.

MP 3811

EFFECT OF COLOR AND TEXTURE ON THE SURFACE TEMPERATURE OF ASPHALT CONCRETE PAVEMENTS.

Berg, R.L., U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, May 1985, 69p., 18 refs. For another version see 38-1110.

50-4362

BITUMINOUS CONCRETES, PAVEMENTS, SEASONAL FREEZE THAW, RADIATION ABSORPTION, ALBEDO, SURFACE TEMPERATURE, PERMAFROST PRESERVATION, THAW DEPTH, THAW WEAKENING, TEMPERATURE CONTROL, TEMPERATURE MEASUREMENT, SEALING, PROTECTIVE COATINGS

This study evaluates the effects of surface color and texture on the thawing season surface temperatures of an asphaltic concrete roadway pavement in Fairbanks, AK. The roadway, Peger Road, carries a substantial volume of automobile and truck traffic daily; therefore, this study differs from most previous surface temperature studies of pavements that were not subjected to significant traffic-generated air turbulence and to the effects of tire wear on the surface treatments.

MP 3812

MATHEMATICAL MODEL OF FROST HEAVE AND THAW SETTLEMENT IN PAVEMENTS—DRAFT.

Guymon, G.L., Berg, R.L., Johnson, T.C., Hromadka, T.V., II, U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, Sep. 1986, 80p. + append., 46 refs. For another version see 47-4870.

50-4348

PAVEMENT BASES, SUBGRADE SOILS, FROZEN GROUND MECHANICS, SOIL TESTS, SOIL FREEZING, FROST HEAVE, FROST ACTION, THAW WEAKENING, SOIL WATER MIGRATION, ICE WATER INTERFACE, TEMPERATURE EFFECTS, DESIGN CRITERIA, MATHEMATICAL MODELS

MP 3813

NEW ICE JAM DATABASE.

White, K.D., *Water resources bulletin*, Apr. 1996, 32(2), p.341-348, 10 refs.

50-4410

RIVER FLOW, RIVER ICE, ICE JAMS, DISTRIBUTION, PERIODIC VARIATIONS, FLOOD FORECASTING, STATISTICAL ANALYSIS, CLASSIFICATIONS, WATER SUPPLY, WATER BALANCE

Ice jam data are often difficult to locate, and doing so requires a search of many different data sources. The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) has compiled an Ice Jam Database that provides information on nearly 9300 ice events in the United States. The information may be quantitative (e.g., event stage or discharge), qualitative (e.g., a narrative description), or a combination of both. References are provided to serve as a basis for further investigation. Although some selection bias may exist in the database because of its reliance on certain data sources, the database can be an asset in water resources planning and engineering. This paper is an overview of the CRREL Ice Jam Database and presents two applications of it.

MP 3814

NUMERICAL SOLUTION OF THE TWO-DIMENSIONAL TRANSIENT TEMPERATURE DISTRIBUTION IN MELTING AND SOLIDIFYING COMPOSITE MEDIA. FINAL REPORT.

Hashemi, H.T., Sliepcevich, C.M., Norman, OK, University of Oklahoma Research Institute, May 1966, 69p., 4 refs. Supported by the U.S. Army Cold Regions Research and Engineering Laboratory through Grant No.DA-AMC-27-021-65-G12.

50-4605

SOIL FREEZING, GROUND THAWING, FROZEN GROUND THERMODYNAMICS, FROZEN GROUND TEMPERATURE, TEMPERATURE DISTRIBUTION, CONDUCTION, COMPUTERIZED SIMULATION, MATHEMATICAL MODELS

MP 3815

NUMERICAL SOLUTION OF THE TWO-DIMENSIONAL TRANSIENT TEMPERATURE DISTRIBUTION WITH CHANGE OF PHASE AND BULK FLOW IN POROUS MEDIA. FINAL REPORT.

Hashemi, H.T., Sliepcevich, C.M., Norman, OK, University of Oklahoma Research Institute, May 1966, 49p., 4 refs. Supported by the U.S. Army Cold Regions Research and Engineering Laboratory through Grant No.DA-AMC-27-021-66-G19.

50-4606

UNDERGROUND PIPELINES, PIPELINE FREEZING, ARTIFICIAL FREEZING, SOIL FREEZING, FROZEN GROUND

THERMODYNAMICS, FREEZING FRONT, GROUND WATER, COMPUTER PROGRAMS, MATHEMATICAL MODELS

MP 3816

SELECTION OF COLD-TOLERANT PLANTS FOR GROWTH IN SOILS CONTAMINATED WITH ORGANICS.

Rogers, H.B., Beyrouthy, C.A., Nichols, T.D., Wolf, D.C., Reynolds, C.M., *Journal of soil contamination*, 1996, 5(2), p.171-186, 24 refs.

50-4609

SOIL POLLUTION, SOIL CHEMISTRY, SOIL MICROBIOLOGY, OIL SPILLS, LAND RECLAMATION, INTRODUCED PLANTS, REVEGETATION, PLANT PHYSIOLOGY, GROWTH, ACCLIMATIZATION, COLD TOLERANCE

A mixture of organic chemicals (MOC) containing equal molar amounts of benzoic acid, hexadecane, 2,2-dimethyl 4,n-propylbenzene, phenanthrene, pyrene, and either cycloheptane or cis-decahydronaphthalene (cis-decalin) was applied to soil at rates of 0 to 8000 mg/kg. In a plant-screening experiment, growth responses of four legume and five nonlegume species were determined at 10 and 25°C. The MOC applied at 2000 mg/kg reduced the growth of several species without resulting in significant seedling death. At 10°C, the growth of alpine bluegrass (*Poa alpina* L.) in the 1000 and 2000 mg/kg treatments of soil increased by more than 185%. In a plant growth response experiment, alpine bluegrass and alfalfa (*Medicago sativa* L.) were grown in soil that had been contaminated at rates of 0 and 2000 mg/kg. At 14 weeks, the shoot and root dry weights of alfalfa were 97% lower in the contaminated soil, while the shoot dry weight, root dry weight, and root length of alpine bluegrass were 135, 235, and 268% higher, respectively. Except for pyrene, <23% of the compounds comprising the MOC remained in the soil after 4 weeks and <5% after 14 weeks. The disappearance of the MOC was not significantly influenced by the presence of alfalfa or alpine bluegrass.

MP 3817

WINTER METHANE DYNAMICS BENEATH ICE AND IN SNOW IN A TEMPERATE POOR FEN.

Melloh, R.A., Crill, P.M., *Hydrological processes*, 1995, Vol.9, p.947-956, 22 refs. For another version see 50-3127.

50-4610

WETLANDS, PEAT, SOIL CHEMISTRY, SOIL AIR INTERFACE, SNOWFALL, SNOW COMPOSITION, SNOW COVER EFFECT, SNOW AIR INTERFACE, NUTRIENT CYCLE

The influence of winter on methane (CH₄) stored in pore water and emitted through snow was investigated in a temperate poor fen in New Hampshire over two winters. Methane accumulated beneath ice layers (1 cm) deposited by freezing rain, resulting in snow-pore air mixing ratios as high as 140 ppmv during the first winter and 600 ppmv during the second. An early winter snow crust of 300 kg/m² caused no discontinuity in a linear mixing ratio profile and therefore was not observed to retard snowpack emissions. Methane concentration-depth profiles in pore water steepened and concentrations increased by as much as 400 µm at the 10 and 20 cm depths as the ice cover formed. This suggests that the peat-ice cover plays an important part in CH₄ build-up in pore water by limiting the transport of gases between the peat and the atmosphere. Pore water concentrations gradually declined through late winter. The seasonality of dissolved CH₄ in pore water over two winters and one summer showed an average annual amplitude of 1.3 g CH₄/m² (25-75 cm depth range), with a winter maximum of 4.7 g CH₄/m². Emissions during the winter with average snowfall accounted for a larger percentage (9.2% in 1993-94) of total annual emission than the winter with below-average snowfall and warmer air temperature (2% in 1994-95). Emissions averaged 56 and 26 mg/m²/day during the first and second winter (Dec., Jan. and Feb.), respectively.

MP 3818

SNOW.

Colbeck, S.C., Encyclopedia of climate and weather. Vol.2. Edited by S.H. Schneider, New York, Oxford University Press, 1996, p.697-699, 4 refs.

50-4614

SNOW PHYSICS, DICTIONARIES, SNOW HYDROLOGY, CLIMATOLOGY, SNOW COVER EFFECT, SNOW COVER STRUCTURE, PHYSICAL PROPERTIES, CHEMICAL PROPERTIES, ICE WATER INTERFACE

MP 3819

SNOW COVER.

Colbeck, S.C., Encyclopedia of climate and weather. Vol.2. Edited by S.H. Schneider, New York, Oxford University Press, 1996, p.699-700, 3 refs.

50-4615

CLIMATOLOGY, DICTIONARIES, SNOW COVER DISTRIBUTION, SNOW COVER STRUCTURE, SNOW COVER EFFECT, SNOW THERMAL PROPERTIES, INSULATION

MP 3820

SCIENTIST JOINS ELITE GROUP.

Darling, M., *U.S. Army Corps of Engineers. Engineer update*, May 1996, 20(5), p.4.

50-4620

GLACIOLOGY, RESEARCH PROJECTS

MP 3821

PROBABILITY DISTRIBUTIONS FOR PEAK STAGE ON RIVERS AFFECTED BY ICE JAMS.

Tuthill, A.M., Wuebben, J.L., Daly, S.F., White, K.D., *Journal of cold regions engineering*, Mar. 1996, 10(1), p.36-57, 18 refs.

50-4754

RIVER FLOW, FLOW RATE, RIVER ICE, ICE BREAKUP, FLOOD FORECASTING, ICE JAMS, WATER LEVEL, SEASONAL VARIATIONS, CLASSIFICATIONS, STATISTICAL ANALYSIS, ICE COVER EFFECT

This paper presents a new method for estimating winter peak stage along a river reach by dividing the record of winter peak discharges into distinct ice-jam and no-ice-jam populations. Rating curves may then be developed for each population using gradually-varied flow analysis and existing equilibrium ice-jam theory. Stage-probability distributions for the ice jam and no-ice-jam populations may then be combined into a single stage-frequency relationship representing the entire winter period. A case study is presented, in which the method is used to develop probability distributions for the annual maximum stage along the Winoski River at Montpelier, VT. Viewed in the context of the historical record, the method yields reasonable results. (Auth. mod.)

MP 3822

CORN SNOW—TODAY'S SKIING, TOMORROW'S MELT WATER.

Colbeck, S.C., *Avalanche review*, Apr. 1996, 14(6), p.1,3.

50-4758

SNOW HYDROLOGY, SNOW STRENGTH, SNOW COVER STRUCTURE, SNOW CRYSTAL STRUCTURE, ICE WATER INTERFACE, FREEZE THAW CYCLES, COALESCENCE, INSOLATION, CLASSIFICATIONS, WET SNOW

MP 3823

FLUX OF DEBRIS TRANSPORTED BY ICE AT THREE ALASKAN TIDEWATER GLACIERS.

Hunter, L.E., Powell, R.D., Lawson, D.E., *Journal of glaciology*, 1996, 42(140), p.123-135, 58 refs.

50-4897

GLACIOLOGY, GLACIER FLOW, GLACIAL GEOLOGY, SHORES, ICE SOLID INTERFACE, SEDIMENT TRANSPORT, GROUND ICE, GLACIER BEDS, MORAINES, CALVING, ICE RAFTING, ICE SAMPLING, UNITED STATES—ALASKA—GLACIER BAY

The stability of a tidewater terminus is controlled by glacial dynamics, calving processes and sedimentary processes at the grounding line. An investigation of grounding-line sediment dynamics and moraine-bank sediment budgets in Glacier Bay, AK, U.S.A., has yielded data that enable one to determine the debris fluxes of Grand Pacific, Margerie and Muir Glaciers. Debris flux ranges from 10^3 to 10^6 m³/a, one to two orders of magnitude lower than the glacial fluvial sediment fluxes. Combined, these fluxes represent the highest yields known for glacierized basins. Large debris fluxes reflect the combined effects of rapid glacier flow, driven by the maritime climate of southeast Alaska, and highly erodible bedrock. Englaciated-debris distribution is affected by valley width and relief, both of which control the availability of sediment. The number of tributaries controls the distribution and volume of debris in englacial and supraglacial moraines. At the terminus, iceberg-rafting removes up to two orders by magnitude more sediment from the ice-proximal environment than is deposited by melt-out or is dumped during calving events. Rough estimates of the sediment flux by deforming beds suggests that soft-bed deformation may deliver up to an order of magnitude more sediment to the terminus than is released from within the glacier ice. (Auth. mod.)

MP 3824

OBSERVATIONS OF PRESSURE EFFECTS ON THE CREEP OF ICE SINGLE CRYSTALS.

Cole, D.M., *Journal of glaciology*, 1996, 42(140), p.169-175, 17 refs.

50-4901

ICE MECHANICS, GLACIOLOGY, BASAL SLIDING, ICE CREEP, ICE CRYSTALS, ICE SOLID INTERFACE, STRAIN TESTS, PLASTIC DEFORMATION, HIGH PRESSURE TESTS, SIMULATION

Glaciological experiments performed on ice single crystals oriented for basal slip indicate that the steady-state creep rate is only marginally affected by confining pressure up to 19 MPa, at a constant absolute temperature of 263 K. The observations contradict earlier work at similar pressures and the disparity is examined in terms of experimental errors.

MP 3825

HEAT FLUX THROUGH SEA ICE IN THE WESTERN WEDDELL SEA: CONVECTIVE AND CONDUCTIVE TRANSFER PROCESSES.

Lytle, V.L., Ackley, S.F., *Journal of geophysical research*, Apr. 15, 1996, 101(C4), p.8853-8868, 27 refs.

50-5263

OCEANOGRAPHY, SEA ICE, ICE COVER THICKNESS, ICE HEAT FLUX, AIR ICE WATER INTERACTION, CONVECTION, SNOW ICE INTERFACE, SNOW COVER EFFECT, ICE COVER EFFECT, ICE GROWTH, SLUSH, TEMPERATURE MEASUREMENT, PROFILES, ANTARCTICA—WEDDELL SEA

The heat flux through the snow and sea ice cover and at the ice/ocean interface were calculated at five sites in the western Weddell Sea during autumn and early winter 1992. In late Feb., three of the five sites had a slush layer at the snow/ice interface. As this slush layer froze to form snow ice, the dense brine which was rejected flowed out through brine drainage channels and was replaced by lower-salinity, nutrient-rich seawater from the ocean upper layer. As the slush layer froze over a 2-3 week period, the convection within the ice transported salt from the ice to the upper ocean and increased total heat flux through the overlying ice and snow cover. On an area-wide basis, approximately 10 cm of snow ice growth occurred within second-year pack ice. This ice growth, near the surface of the ice, provides a salt flux to the upper ocean equivalent to 5 cm of ice growth, despite the thick (about 1 m) ice cover, in addition to the ice growth in the small (area less than 5%) open water regions. (Auth. mod.)

MP 3826

ATMOSPHERIC ICE ABLATION PROCESSES ON MT. EQUINOX, VERMONT, U.S.A.

Ryerson, C.C., Kenyon, P., International Workshop on Atmospheric Icing of Structures, 7th, Chicoutimi, Quebec, June 3-7, 1996. Proceedings. IWAIS '96. Edited by M. Farzaneh and J. Laflamme, Chicoutimi, Université du Québec, 1996, p.277-281, 13 refs.

50-5375

ICE ACCRETION, ICE ADHESION, GLAZE, ICE AIR INTERFACE, ABLATION, ICE SUBLIMATION, ICE MELTING, ICE BREAKING, ICE REMOVAL, WIND FACTORS, UNITED STATES—VERMONT

The purpose of this study is to determine the meteorological conditions associated with natural ablation of atmospheric ice. Atmospheric icing events were recorded by time-lapse video for portions of two winters at an elevation of 1006 m on Mt. Equinox, VT, U.S.A. Seventy-seven ablation periods were identified and compiled. Daily weather patterns, air temperature, humidity, wind direction and wind speed are related to ablation events observed on the video.

MP 3827

SIMPLE MODEL FOR FREEZING RAIN ICE LOADS.

Jones, K.F., International Workshop on Atmospheric Icing of Structures, 7th, Chicoutimi, Quebec, June 3-7, 1996. Proceedings. IWAIS '96. Edited by M. Farzaneh and J. Laflamme, Chicoutimi, Université du Québec, 1996, p.412-416, 12 refs.

50-5399

ICE STORMS, ICE ACCRETION, ICING RATE, ICE LOADS, ICE FORECASTING, WIND FACTORS, PRECIPITATION (METEOROLOGY), METEOROLOGICAL DATA, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION

There are many models for hindcasting ice loads from meteorological data measured during freezing rain storms. Each model is based on the physics of the ice accretion process and on empirical observations. However, these models predict significantly different ice loads for the same freezing rain storm, making it difficult to use them to determine design ice loads. In this paper the author describes a simple ice load model that can be used in back-of-the-envelope calculations of ice loads based on the precipitation rate and wind speed. Using historical weather data from Springfield, IL, the author compares the ice loads from this model with those from other models. The modeled and measured ice loads are also compared from one storm that occurred at CRREL's freezing rain weather station.

MP 3830

CONTAMINATION OF GROUNDWATERS.

Adriano, D.C., ed, Iskandar, I.K., ed, Murarka, I.P., ed, *Advances in environmental science*, Northwood, Middlesex, Science Reviews, 1994, 525p., Numerous refs. passim.

50-5515

SOIL POLLUTION, GROUND WATER, WATER POLLUTION, SOIL WATER MIGRATION, SOIL CHEMISTRY

MP 3831

COMMENT ON "EQUATION OF STATE FOR EXTRAPOLATION OF HIGH-PRESSURE SHOCK HUGONOT DATA".

Johnson, J.B., *Journal of applied physics*, Sep. 15, 1995, 78(6), p.4300-4302, 10 refs.

50-5592

SHOCK WAVES, WAVE PROPAGATION, THERMODYNAMICS, COMPRESSIVE PROPERTIES, HIGH PRESSURE TESTS, UNDERWATER ACOUSTICS, MATHEMATICAL MODELS

Oh and Persson (1989) proposed an equation of state to extrapolate high-pressure shock Hugoniot data to other high-pressure and high-temperature states and compared it to data. The requirement that $F = -(dE/dV)/(dP/dV)_{H=1}$ (E is specific internal energy, V is specific volume, P is the constant pressure path and H is the constant Hugoniot path) needed to establish the equation of state appears to be in error. The author has found F to vary from 0.16 to 3.59 for fifteen common materials of interest to shock physicists. Oh and Persson's (1989) comparison of their equation of state to data gives the impression of a better agreement than actually occurs because of possible errors in the transcription of data, and the use of an inappropriate Hugoniot for water. When data are correctly plotted and an appropriate water Hugoniot is used, the comparison of data with theory indicates that the equation of state loses accuracy with increasing pressure or decreasing porous initial density.

MP 3832

LONG-TERM PLANT PERSISTENCE ON HIGHLY ACIDIC SOILS AMENDED WITH ORGANIC MATERIALS IN TWO CLIMATIC ZONES.

Palazzo, A.J., Lee, C.R., Price, R., International Symposium on Plant-Soil Interactions at Low pH, 3rd, Brisbane, Australia, Sep. 12-16, 1993, Dordrecht, Kluwer Academic Publishers, 1995, p.605-610, 15 refs.

50-5593

PLANT ECOLOGY, PLANT PHYSIOLOGY, REVEGETATION, GRASSES, SOIL CHEMISTRY, SOIL POLLUTION, SOIL CONSERVATION, LAND RECLAMATION

Little information is available on long-term plant persistence and invasion on amended pyritic soils. This study evaluated the persistence of cool- and warm-season plants grown in two climatic zones on amended acidic soils (pH 3.0 or less) disturbed by large earth-moving operations in constructing or widening waterways. Soils in both studies were amended with lime and organic materials (sewage sludge at 100 t/ha or chicken manure at 80 t/ha), which increased pH and improved soil fertility. The results show that organic soil amendments are beneficial for establishing and maintaining a plant cover on highly acidic soils. The plants originally sown, however, did not always persist. The type of invading species depended on the kind of organic amendment applied. When chicken manure was applied, invading plants initially included weedy grasses and later included plants growing in adjacent plots and other perennial species; in the sludge site, plant invasion was primarily from adjacent study areas. In the warm-humid climate (Mississippi), *Sericea lespedeza* was the most effective colonizer after four years, even without heavy applications of organic soil amendments. This plant later spread into areas sown to either bahiagrass or weeping lovegrass, which were not as persistent. Kentucky bluegrass was the most persistent species in the northern climate (Delaware) after seven years, with a mean soil cover of 81%. This species was followed by tall fescue at 53% and the cultivars of fine fescues at 22%. The ryegrasses and bentgrasses did not persist.

MP 3833

SIMULATED TRANSPORT OF THREE CATIONS THROUGH POROUS MEDIA: EFFECT OF DIFFERENT APPROACHES TO MODELING CATION EXCHANGE REACTIONS.

Grant, S.A., Mansell, R.S., Bloom, S.A., Rhue, R.D., *Water resources research*, Jan. 1995, 31(1), p.185-198, 40 refs.

50-5598

HYDROGEOCHEMISTRY, SOIL CHEMISTRY, SOIL WATER MIGRATION, ION EXCHANGE, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION

Batch cation exchange and column experiments were conducted to evaluate selectivity coefficients which have been suggested for describing cation exchange reactions in solute transport models. Vanselow selectivity coefficients were calculated for cation exchange equilibria with a cation resin and for equilibria reported in the literature with a Yolo loam soil. Experimental column data were compared with data from simulations generated by a numerical solute transport model to evaluate Vanselow, Gaines-Thomas, and statistical thermodynamic selectivity coefficients. With the cation resin, the statistical thermodynamic selectivity coefficient gave the most reliable estimate of column effluent cation concentrations. In a column packed with the Yolo loam soil, the Vanselow selectivity coefficient gave the most accurate prediction of column response. Use of variable rather than fixed Vanselow selectivity coefficients gave more accurate predictions of column experiments. The use of ternary cation exchange data did

not improve predictions of column response.

MP 3834

RATES OF EROSION AND SEDIMENT EVACUATION BY GLACIERS: A REVIEW OF FIELD DATA AND THEIR IMPLICATIONS.

Hallet, B., Hunter, L., Bogen, J., *Global and planetary change*, Mar. 1996, 12(1-4), European program "Late Cenozoic Evolution of the Polar North Atlantic Margins" (PONAM), Fjærland, Norway, May 30-June 2, 1994. Workshop, selected papers, p.213-235, 41 refs.

50-5317

GLACIAL GEOLOGY, GEOMORPHOLOGY, GLACIAL EROSION, GLACIAL DEPOSITS, ALPINE GLACIATION, RIVER BASINS, SEDIMENT TRANSPORT, CLASSIFICATIONS

MP 3835

LOW-TEMPERATURE AND FREEZE-THAW DURABILITY OF THICK COMPOSITES.

Dutta, P.K., Hui, D., *Composites: Part B, Engineering*, 1996, 27B(3/4), p.371-379, 25 refs.

50-5659

COMPOSITE MATERIALS, POLYMERS, PLASTICS, FROST RESISTANCE, FREEZE THAW TESTS, LOW TEMPERATURE TESTS, COLD STRESS, COLD WEATHER PERFORMANCE

Low temperature produces internal stresses in composites of polymeric materials. The polymeric matrix phase becomes stiffer, and may suffer from damage-inducing stresses resulting from thermal coefficient mismatch of fibers and resins. These influences have been studied by subjecting two types of FRP composites to flexural tests. A commercially procured fiber reinforced plastic (FRP) composite indeed produced cracks on prolonged thermal cycling between 50°C and -60°C temperatures. But a specially manufactured woven glass reinforced FRP did not produce any visible cracks for two and half times more thermal cycling over the same temperature range. It is suspected that the resin type and the curing process control the thermal cycle response and ultimate durability of such FRP composites in extreme temperature environments.

MP 3836

PERFORMANCE CHARACTERIZATION OF A LABORATORY-SCALE BIOREACTOR WITH LIQUID SUSPENSIONS OF *ALCALIGENES EUTROPHUS* JMP134.

McKay, D.J., Morse, J.S., *Hazardous waste & hazardous materials*, 1995, 12(3), p.195-206, 30 refs.

50-5660

WATER POLLUTION, SOIL POLLUTION, SOIL MICROBIOLOGY, SOIL CHEMISTRY, WASTE TREATMENT, BACTERIA, DECOMPOSITION

Trichloroethylene (TCE) was degraded in a single-stage, continuously stirred tank reactor (CSTR) bioreactor containing pure cultures of liquid-dispersed *Alcaligenes eutrophus* JMP134. Phenol was supplied as the sole source of carbon and energy for induction of catabolic activities. Operating conditions were varied in a series of randomly ordered experiments. The independent variables were influent TCE concentration, influent phenol concentration, and hydraulic residence time. The dependent variable was the percent of influent TCE degraded or degradation efficiency. The highest degradation efficiency observed was 98.6%. An empirical equation was fitted to the data in the form of degradation efficiency as a function of the three independent variables. A close match was achieved between the equation and the data. This equation is valid only where the phenol is oxidized below the level of detection in the effluent (150 micro-g/L). The equation is useful for bioreactor design and operation.

MP 3837

RESULTS OF THE MILLIMETER-WAVE INSTRUMENT OPERATED AT SEVILLETA, NEW MEXICO.

Otto, W.D., et al, *U.S. National Oceanic and Atmospheric Administration. Environmental Research Laboratories. Environmental Technology Laboratory. NOAA technical memorandum*, Feb. 1996, ERL ETL-262, 43p., 4 refs.

50-5666

SOIL AIR INTERFACE, HEAT FLUX, HUMIDITY, ATMOSPHERIC BOUNDARY LAYER, ATMOSPHERIC ATTENUATION, ATMOSPHERIC DENSITY, SCINTILLATION, METEOROLOGICAL INSTRUMENTS

Values of the refractive structure parameter C_n^2 are obtained from atmospheric scintillation by a 3.2-mm wavelength instrument. The results from this instrument are compared with those obtained from three other scintillometers and from C_n^2 calculated from micrometeorological data.

MP 3838

DISORDER OF ORGANIZATIONAL LOGIC—MAKEDWORK AMONG MEMBERS OF BUREAUCRATIC ORGANIZATIONS.

Masuch, M., LaPotin, P.J., *Logic of organizational disorder*, Berlin, Walter de Gruyter & Co., 1996, p.145-162, 48 refs.

50-5671

ORGANIZATIONS, HUMAN FACTORS, LABOR FACTORS

MP 3839

ICE ACCUMULATION ON FIXED AND FLOATING OCEAN STRUCTURES.

Minsk, L.D., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Sep. 1975, 70p. + appends., Refs. p.64-70.

50-5755

SHIP ICING, ICE ACCRETION, ICE LOADS, ICE FORECASTING, OFFSHORE STRUCTURES

MP 3840

1971 PERFORMANCE SURVEY OF DEW LINE ICE CAP STATIONS DYE-2 AND DYE-3.

Flax, D., Hine, G., Tobiasson, W., Whisler, B., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, Dec. 1971, 44p., 5 refs.

50-5756

SITE SURVEYS, STATIONS, COLD WEATHER OPERATION, COLD WEATHER CONSTRUCTION, MILITARY FACILITIES, RADAR, GREENLAND

MP 3841

FEASIBILITY STUDY OF FOXHOLE EXCAVATION BY COMPRESSED GAS BLASTING.

Mellor, M., Kovacs, A., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, June 1971, 22p., 6 refs.

50-5757

FROZEN GROUND STRENGTH, EXCAVATION, BLASTING, EXPLOSIVES, MILITARY EQUIPMENT

MP 3842

HARDNESS OF SINGLE ICE CRYSTALS.

Butkovich, T.R., *American mineralogist*, Jan.-Feb. 1958, Vol.43, p.48-57, 5 refs. For another version see 24-3170.

50-5759

ICE CRYSTAL STRUCTURE, ICE HARDNESS

Brinell and scratch hardness tests were made on single ice crystals. The results of these measurements show that the hardness of single ice crystals increases with decreasing temperature; the Brinell numbers range from about 4 at -5°C to 17 at -50°C. The greatest increase in the hardness values occurs at the higher temperatures. The temperature dependence of the scratch hardness was similar to that of Brinell hardness. An anisotropy of hardness is evident; the single ice crystal is harder parallel to the c-axis than in the direction normal to the c-axis. An apparent difference in surface structure with respect to orientation was noticed during the scratch hardness tests. A consistent wavy scratch was produced normal to the c-axis, while the scratch parallel to the c-axis was always straight.

MP 3843

EXPLOSIVES IN FROZEN GROUND.

Roberts, A., Hanover, NH, U.S. Army Cold Regions Research and Engineering Laboratory, 1971, 242p. (2 vols.), 110 refs.

50-5763

ROCK EXCAVATION, TUNNELING (EXCAVATION), FROZEN GROUND STRENGTH, FROZEN GROUND STRENGTH, FROZEN GROUND MECHANICS, BLASTING, EXPLOSIVES, EXPLOSION EFFECTS, DETONATION WAVES

MP 3844

DOPPLER RADAR FOR CONTINUOUS REMOTE MEASUREMENT OF RIVER ICE VELOCITY.

Ferrick, M.G., Yankielun, N.E., Nelson, D.F., *Canadian journal of civil engineering*, Apr. 1996, 23(2), p.408-417, With French summary. 12 refs. For another version see 50-4247.

50-5810

RIVER FLOW, RIVER ICE, ICE FLOES, ICE BREAKUP, FRAZIL ICE, VELOCITY MEASUREMENT, RADAR ECHOES, BACKSCATTERING, IMAGING, ACCURACY, CORRELATION

River ice velocity measurements are fundamental to analyses of river ice dynamics. Ice velocity measurement with a continuous-wave Doppler radar system having real-time data acquisition and digital signal processing capability was evaluated during a river breakup and a frazil run on the Connecticut River. This system can be rapidly deployed, requires minimal operator interaction, will continuously acquire, process, store, and display ice velocity

data, and does not depend on visibility conditions. In parallel, video records of ice motion were obtained at the same location for later manual processing and comparison with the radar results. The authors describe the Doppler radar system and obtain bounding estimates of possible measurement errors. The principal error in Doppler ice velocity measurement is due to the beamwidth of the radar antenna, and an analytical method is developed to minimize this error. Measured ice velocities ranged from 1 to 2.5 m/s during the river breakup, and from 0.5 to 0.65 m/s in the frazil run. Quantitative comparisons between the radar and video results show fundamental agreement between these measurement methods, and demonstrate that Doppler radar is an effective, efficient, and precise tool for obtaining river ice velocities over the full range of possible ice and velocity conditions.

MP 3845

DREDGING EAGLE RIVER FLATS: REMEDIATION STUDY IN AN ACTIVE IMPACT AREA.

Walsh, M.R., UXO (Unexploded Ordnance) Forum 1996, Williamsburg, VA, Mar. 26-28, 1996. Conference proceedings, Alexandria, VA, U.S. Department of Defense Explosives Safety Board, 1996, p.266-274, 15 refs.

50-5913

SOIL POLLUTION, WATER POLLUTION, ENVIRONMENTAL IMPACT, EXPLOSIVES, WASTE DISPOSAL, LAND RECLAMATION, DREDGING, MILITARY FACILITIES, UNITED STATES—ALASKA—FORT RICHARDSON

Remediation in closed impact areas is hazardous because of the presence of unexploded ordnance (UXOs). Remediation of active impact areas compounds the problems due to the infusion of fresh UXOs. At Eagle River Flats, AK, massive waterfowl die-offs at the Army's impact area triggered an investigation as to the causes of mortality. With the discovery of white phosphorus from smoke rounds as the causal agent, a large, unprecedented multifaceted remedial investigation was initiated. Studies at the Flats can be categorized as either ecological assessments or remedial investigations. Ecological assessments considered the physical and biological dynamics of the Flats and the impact of these factors on the presence of white phosphorus and vice versa. Remedial investigations centered around removal for treatment in a controlled environment, *in-situ* remediation, or burial. Dredging is included in the first category. The objective of the experimental dredging project at Eagle River Flats is the removal of white phosphorus contaminated sediments from the Flats for treatment.

MP 3846

SAMPLE REPRESENTATIVENESS: THE MISSING ELEMENT IN EXPLOSIVES SITE CHARACTERIZATION.

Jenkins, T.F., Grant, C.L., Brar, G.S., Thorne, P.G., Schumacher, P.W., Ranney, T.A., *Environmental Symposium & Exhibition*, 22nd, Orlando, FL, Mar. 18-21, 1996. Proceedings, American Defense Preparedness Association, 1996, p.517-522, 4 refs.

50-5960

SOIL POLLUTION, SOIL TESTS, CHEMICAL ANALYSIS, SAMPLING, EXPLOSIVES, SEDIMENTS, STABILITY, LABORATORY TECHNIQUES, ACCURACY, STATISTICAL ANALYSIS

This study was conducted to assess the degree of short-range heterogeneity in analyte concentrations present at explosives-contaminated sites. Such information is essential if sampling methods are to be established that provide representative samples for analysis and from which informed decisions can be made. Soil sampling was conducted at nine sampling locations on three installations. Seven discrete grab samples were collected in a wheel pattern of radius 61 cm (one sample from the center and six around the perimeter). Each of the seven samples was homogenized in the field and duplicates were analyzed by an on-site colorimetric method as well as being sent for off-site analysis using EPA Method 8330. Results indicate that TNT concentrations varied substantially at all sampling locations; concentrations varied as much as 2½ orders of magnitude within a sampling wheel. Partitioning of overall variances indicated that sampling error dominated over analytical error. Therefore, the probability of collecting discrete samples that represent average analyte concentrations is very unlikely with these levels of heterogeneity. A combination of composite sampling, on-site homogenization, and on-site colorimetric analysis provided an inexpensive and rapid site-characterization procedure that was accurate and precise, and provided results that were representative of site conditions.

MP 3847

NEW APPROACH TO EVALUATING PRE-ANALYSIS HOLDING TIMES FOR THE DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN SOIL.

Hewitt, A.D., *Volatile compounds in the environment*. Edited by W. Wang et al, American Society for Testing and Materials, 1996, p.181-191, ASTM STP 1261, 14 refs.

50-5961

WASTE DISPOSAL, SOIL POLLUTION, HYDROCARBONS, SOIL TESTS, VAPOR DIFFUSION, SAMPLING, STABILITY, DEGRADATION, STORAGE, LABORATORY

TECHNIQUES, SEALING

In the absence of volatilization losses, the short-term concentration stabilities of benzene, toluene, trans-1,2-dichloroethylene, and trichloroethylene were assessed in soil subsamples. Previous holding time studies for this matrix failed to eliminate volatilization as a variable, making them difficult to interpret. Here, vapor-fortified soil subsamples held in sealed glass ampoules for 14 days at 22°C experienced appreciable reductions in benzene and toluene concentrations, presumably attributable to biodegradation. When the same fortified soil was held as a subsample for either headspace or purge-and-trap analyses, it showed an appreciable reduction in toluene and a complete loss of benzene over a 14-day holding period at 4°C. In contrast, fortified soils held in sealed glass ampoules at 4°C, or dispersed in methanol and held at 22°C, showed no significant analyte losses over periods of 20 and 98 days, respectively.

MP 3848

EFFECT OF COLLECTION AND HANDLING PRACTICES ON CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS DETECTED IN SOIL SUBSAMPLES.

Hewitt, A.D., Volatile compounds in the environment. Edited by W. Wang et al, American Society for Testing and Materials, 1996, p.170-180, ASTM STP 1261, 14 refs.

50-5962

WASTE DISPOSAL, SOIL TESTS, SAMPLING, SOIL POLLUTION, HYDROCARBONS, WELLS, BOREHOLES, LABORATORY TECHNIQUES, DEGRADATION, ACCURACY, ENVIRONMENTAL TESTS

The losses of trichloroethylene from soil samples transferred to and from a storage bottle were evaluated by comparing values obtained using standard techniques with values obtained using a method that limits sample disruption, exposure, and volatilization losses from a subsample after a single transfer step. Results strongly suggest that volatile organic compounds (VOCs) are easily lost from contaminated soils if care is not taken to limit surface area exposure and ensure subsample isolation. For this site investigation and others using similar sample-handling protocols, VOC losses are most abundant during field collection and storage.

MP 3849

CALCULATION OF TEMPERATURE EFFECTS ON WETTING COEFFICIENTS OF POROUS SOLIDS AND THEIR CAPILLARY PRESSURE FUNCTIONS.

Grant, S.A., Salehzadeh, A., *Water resources research*, Feb. 1996, 32(2), p.261-270, 30 refs.

50-5965

SOIL PHYSICS, POROSITY, CAPILLARITY, SOIL WATER MIGRATION, SATURATION, VAPOR PRESSURE, TEMPERATURE EFFECTS, TEMPERATURE VARIATIONS, THERMODYNAMIC PROPERTIES, INTERFACIAL TENSION, MATHEMATICAL MODELS, ENTHALPY

The authors explore the notion that changes in wetting coefficients of porous solids contribute to the temperature sensitivities of capillary pressure functions (CPFs). A chemical-thermodynamic explanation for these contributions was developed. If the temperature sensitivities of CPFs were due to capillarity (i.e., due to temperature-induced changes in liquid-gas interfacial tensions or wetting coefficients), then for a given degree of saturation the ratios of capillary pressures to their temperature derivatives should have been linear functions of thermodynamic temperature, with slopes equal to 1. This indeed was the case for samples of both synthetic and natural porous media. Further, the estimated intercepts of these linear functions indicated that changes with temperature of these porous materials' wetting coefficients had pronounced effects on temperature sensitivities of their CPFs. A simple model for temperature effects on CPFs, which was derived from the linear relationship between temperature and the ratio of capillary pressure to its temperature derivative, could be fitted precisely by nonlinear regression to CPFs of two soils determined at four temperatures.

MP 3850

FREEZING DRIVEN UPWELLING IN ANTARCTIC SEA ICE BIOLOGICAL SYSTEMS.

Ackley, S.F., Fritsen, C.H., Lytle, V.I., Sullivan, C.W., NIPR Symposium on Polar Biology, Proceedings. No.9, Tokyo, National Institute of Polar Research, Feb. 1996, p.45-59, 23 refs.

50-6032

PACK ICE, UPWELLING, SEA WATER FREEZING, CONVECTION, ALGAE, MARINE BIOLOGY, ICE COVER EFFECT, ECOLOGY, ANTARCTICA—WEDDELL SEA Within existing ice covers, fluid motion can also be driven by freezing-induced convection. Surface snow-slush and near-surface highly porous layers were found in the pack ice at Ice Station Weddell in the western Weddell Sea at the end of summer and examined for physical and biological processes. Convective fluid motion, driven by brine rejection from the ice freezing from above as air temperatures dropped, replaced nutrient depleted waters in the layers with nutrient-rich sea water from below. The upwelling nutrients fueled autumn blooms of algae in second-

year ice in the near surface regions of the ice cover where sufficient light is also available. Both the timing and location of these blooms within the ice cover are unlike the bottom spring blooms of sea ice algae previously observed. (Auth.)

MP 3851

CAPILLARY BONDING OF WET SURFACES.

Colbeck, S.C., *Surface and coatings technology*, June 1996, 81(2-3), p.209-214, 5 refs.

50-6038

SKIS, PLASTICS SNOW FRICTION, PLASTICS ICE FRICTION, ICE ADHESION, WATER FILMS, INTERFACIAL TENSION, CAPILLARITY, MATHEMATICAL MODELS

Adhesion of wet surfaces to one another through a water film is common and important for a variety of problems. The nature of this adhesion is explored through a simple model of a grooved polyethylene surface, i.e. a ski, adhering to ice. The effects of contact angle and geometry are included. A set of experiments was performed to show how contact area and adhesive force vary with water tension for glass on porous ceramic. The results show that the model describes the general characteristics of the adhesion but further experiments are necessary for materials of particular interest.

MP 3852

ACCURACY OF TRETYAKOV PRECIPITATION GAUGE: RESULT OF WMO INTERCOMPARISON.

Yang, D.Q., Bates, R., Pangburn, T., *Hydrological processes*, Nov.-Dec. 1995, 9(8), p.877-895, 43 refs.

For another version see 50-3115.

50-6044

SNOWFALL, BLOWING SNOW, PRECIPITATION GAGES, SNOW FENCES, WIND FACTORS, WEATHER STATIONS, STATISTICAL ANALYSIS

From 1986 to 1993, the accuracy and performance of the Tretyakov gauge was evaluated during the WMO Solid Precipitation Measurement Intercomparison at 11 stations in Canada, the USA, Russia, Germany, Finland, Romania and Croatia. The double fence intercomparison reference (DFIR) was the reference standard used at all the Intercomparison stations in the Intercomparison. The Intercomparison data collected at the different sites are compatible with respect to the catch ratio (measured/DFIR) for the same gauge, when compared using mean wind speed at the height of the gauge orifice during the observation period. The Intercomparison data for the Tretyakov gauge were compiled from measurements made at these WMO intercomparison sites. These data represent a variety of climates, terrains and exposures. The effects of environmental factors, such as wind speed, wind direction, type of precipitation and temperature, on gauge catch ratios were investigated. Wind speed was found to be the most important factor determining the gauge catch and air temperature had a secondary effect when precipitation was classified into snow, mixed and rain. The results of the analysis of gauge catch ratio versus wind speed and temperature on a daily time step are presented for various types of precipitation.

MP 3853

SCALING SNOWDRIFT DEVELOPMENT RATE.

Lever, J.H., Haehnel, R.B., *Hydrological processes*, Nov.-Dec. 1995, 9(8), p.935-946, 40 refs.

For another version see 50-3114.

50-6047

SNOWDRIFTS, SNOW EROSION, WIND EROSION, SNOW AIR INTERFACE, SNOW LOADS, SNOW FENCES, WIND TUNNELS, ENVIRONMENTAL TESTS, MATHEMATICAL MODELS

For successful snowdrift modelling, measured drift shapes should be geometrically similar to full-scale shapes and develop at rates that scale in a known manner. Consensus exists on most modelling methods and the similitude requirements needed to meet these objectives. A notable exception is the manner to scale drift development rates. A rationale is presented for rate scaling based on an independent model and prototype mass transport measurements. This approach is validated by comparing the rate of drift development for a model Wyoming snow fence with corresponding field data. This method yields excellent agreement, whereas the alternatives differ substantially.

MP 3854

WINTER METHANE DYNAMICS IN A TEMPERATE PEATLAND.

Melloh, R.A., Crill, P.M., *Global biogeochemical cycles*, June 1996, 10(2), p.247-254, 14 refs.

50-6052

CLIMATOLOGY, WETLANDS, FROZEN GROUND MECHANICS, PEAT, SOIL AIR INTERFACE, NATURAL GAS, SOIL FREEZING, FREEZING FRONT, ICE COVER EFFECT, ICE WATER INTERFACE, SNOW AIR INTERFACE, SNOW STRATIGRAPHY, VAPOR DIFFUSION, SAMPLING, SEASONAL VARIATIONS

Methane (CH₄) dynamics in pore water, snow pore air, and surface emissions were investigated in a temperate peat fen in New Hampshire over several winters. Total snowfall and average air temperatures during winter months (defined as Dec., Jan., and Feb.) were climatologic indicators of significant flux rates from this mid-latitude peat fen. Totalling emissions over 5 years that

represent low to average snowfall, winter accounted for 4.3% of emissions to the atmosphere. Winter flux rates were near 55 mg/m²/d for years with average snowfall, and 25 mg/m²/d for years with low snowfall. Concentrations of CH₄ sampled in pore water immediately beneath the ice were highly variable (0 to 1.1 mM). The concentration magnitude and standard deviation increased toward the fen center and correlated with spatial variation in hydrology, peat texture, and peat depth. CH₄ stores increased in the near-surface pore water as the ice cover formed. Seasonal CH₄ buildup in deeper peat began near the end of the growing season, probably due to changing transport mechanisms and temperature effects on solubility.

MP 3855

MANUAL OF PRACTICE FOR AN EFFECTIVE ANTI-ICING PROGRAM: A GUIDE FOR HIGHWAY WINTER MAINTENANCE PERSONNEL.

Ketcham, S.A., Minsk, L.D., Blackburn, R.R., Fleege, E.J., U.S. Department of Transportation. Federal Highway Administration. Office of Engineering Research and Development. Report No.95-202, McLean, June 1996, 63p., 6 refs.

50-6060

ROAD MAINTENANCE, WINTER MAINTENANCE, ROAD ICING, ICE PREVENTION, ANTIFREEZES, BRINES, CHEMICAL COMPOSITION, FREEZING POINTS, MANUALS, ICE CONTROL, SNOW REMOVAL EQUIPMENT

This manual provides information for successful implementation of an effective highway anti-icing program. It is written to guide the maintenance manager in developing a systematic and efficient practice for maintaining roads in the best conditions possible during a winter storm. It describes the significant factors that should be understood and must be addressed in an anti-icing program, with the recognition that the development of the program must be based on the specific needs to the site or region within its reach. The manual includes recommendations for anti-icing practices and guidance for conducting anti-icing operations during specific precipitation and weather events.

MP 3856

MINIMUM THERMAL PROTECTION FOR COLD WEATHER MASONRY.

Korhonen, C.J., Cortez, E.R., Thomas, R.D., International Conference on Cold Regions Engineering, 8th, Fairbanks, AK, Aug. 12-16, 1996. Proceedings. Cold regions infrastructure: an international imperative for the 21st century. Edited by R.F. Carlson, New York, American Society of Civil Engineers, 1996, p.128-140, 3 refs.

50-6118

COLD WEATHER CONSTRUCTION, WINTER CONCRETING, CONCRETE FREEZING, CONCRETE STRENGTH, CONCRETE ADMIXTURES, MASONRY, MORTARS, FREEZE THAW TESTS, FROST PROTECTION, ANTI-FREEZES

A study was conducted to assess ways to minimize thermal protection requirements for cold weather masonry construction. Frost damage immunity thresholds in terms of mortar moisture content and maturity were determined. Correlations of moisture content with time were developed for mortar in contact with masonry units. Guidance for when fresh mortar can be allowed to freeze, how quickly water can be withdrawn from fresh mortar by masonry units, and at what water content mortar first becomes immune to frost damage are provided. The effects of temperature and antifreeze admixtures on the strength and durability of mortar were studied.

MP 3857

RESEARCH PROGRAM FOR REDUCING FROST HEAVE WITH GEOSYNTHETIC CAPILLARY BARRIERS.

Henry, K.S., Ellis, E., International Conference on Cold Regions Engineering, 8th, Fairbanks, AK, Aug. 12-16, 1996. Proceedings. Cold regions infrastructure: an international imperative for the 21st century. Edited by R.F. Carlson, New York, American Society of Civil Engineers, 1996, p.266-277, 19 refs.

50-6129

PAVEMENTS, EMBANKMENTS, SUBGRADE SOILS, SOIL WATER MIGRATION, CAPILLARITY, FROST HEAVE, FROST PROTECTION, GEOTEXTILES, VAPOR BARRIERS, WATERPROOFING, SOIL STABILIZATION A research project co-sponsored by the U.S. Army Corps of Engineers, the Alaska Science and Technology Foundation, and the Alaska Department of Transportation and Public Facilities to develop design criteria for geosynthetic capillary barriers is being conducted at the U.S. Army Cold Regions Research and Engineering Laboratory. The successful use of geosynthetic capillary barriers would allow the use of a greater volume of frost-susceptible soil in roadway and airport embankments, while achieving the same or better pavement performance, resulting in great cost savings. The results of past work with granular capillary barriers in pavements to reduce frost heave provide preliminary guidance for using geosynthetic capillary barriers. This paper describes the experimental program to help define conditions under which geosynthetic capillary barriers will be effective. The primary vari-

ables being examined are geotextile pore size distribution and thickness, as well as rate of heat loss during freezing of soils. The response being measured is rate of frost heave. The selection process for candidate materials includes capillary rise testing and the application of geotextile filtration criteria.

MP 3858

SNOW GUARDS FOR METAL ROOFS.

Tobiasson, W., Buska, J., Groatorex, A., International Conference on Cold Regions Engineering, 8th, Fairbanks, AK, Aug. 12-16, 1996. Proceedings. Cold regions infrastructure: an international imperative for the 21st century. Edited by R.F. Carlson, New York, American Society of Civil Engineers, 1996, p.398-409, 6 refs.

50-6140

ROOFS, SNOW LOADS, SNOW SLIDES, SNOW RETENTION, SNOW STABILIZATION, COLD WEATHER CONSTRUCTION

Sliding snow and ice can damage property, kill people and overload lower roofs. In valleys, moving snow can roll the standing seams onto their side, violating the waterproofing seals within them. Snow guards are used to hold snow on roofs. Some are attached mechanically while others are adhered to the metal roofing. One of the more successful adhesives requires weeks of above-freezing weather to cure properly and thus cannot be installed successfully during the colder portion of the year. Normal "hardware store" silicone adhesive that was tried did not last long. Special, expensive "neutral curing" silicone was moderately successful as a snow guard adhesive. Plastic and aluminum angle snow guards with a peel-and-stick butyl tape did not survive even one mild winter. Set screws are used to attach several commercially available snow guards to the standing seams of metal roofing. They fit some seams well, others poorly. Self-tapping and self-drilling screws have been used with some success when installed with care. Stainless steel structural blind rivets performed well for two winters, but pulled out the third winter when heavier snow loads were present on the roofs. Some damage to snow guards appears to be caused by workers using them for support when moving about on the roof. Improved design guidelines, standards and performance criteria are needed for snow guards on metal roofs.

MP 3859

THREE-DIMENSIONAL SIMULATION OF RIVER ICE JAMS.

Hopkins, M.A., Daly, S.F., Lever, J.H., International Conference on Cold Regions Engineering, 8th, Fairbanks, AK, Aug. 12-16, 1996. Proceedings. Cold regions infrastructure: an international imperative for the 21st century. Edited by R.F. Carlson, New York, American Society of Civil Engineers, 1996, p.582-593, 17 refs.

50-6155

RIVER ICE, ICE BREAKUP, ICE JAMS, ICE PILEUP, ICE LOADS, ICE FORECASTING, ICE CONTROL, ICE WATER INTERFACE, RIVER FLOW, HYDRAULIC STRUCTURES, FLOOD CONTROL, COMPUTERIZED SIMULATION, MATHEMATICAL MODELS

A three-dimensional discrete element model coupled with a one-dimensional depth-averaged unsteady hydraulic model is used to simulate river ice jam formation. Ice runs are arrested by an ice control structure consisting of cylinders spaced across a channel. This type of structure is typically constructed in small, relatively steep rivers to cause temporary ice jams in areas where flooding is not a problem, to protect downstream areas where recurrent flooding is a serious problem. The three-dimensional discrete element simulation consists of several thousand floes. Each floe is a flat circular disk with arbitrary diameter and thickness. Feedback between ice floes and water is through water drag on floes, and partial blockage of the channel by floes. The simulations begin by releasing a large concentration of ice floes upstream of the structure at the flow velocity. As the ice floes move downstream, collisions between neighboring floes and collisions between floes and the channel bottom and ice control structure are explicitly modeled. An ice jam is initiated by arching of floes between the control structures. The momentum of colliding floes and water drag cause the jam to thicken. The arrival of additional ice causes the jam to progress upstream. Concurrently, the ice forces on the structure are determined.

MP 3860

DYNAMICS OF RIVER ICE JAM RELEASE.

Shen, H.T., Lu, S.N., International Conference on Cold Regions Engineering, 8th, Fairbanks, AK, Aug. 12-16, 1996. Proceedings. Cold regions infrastructure: an international imperative for the 21st century. Edited by R.F. Carlson, New York, American Society of Civil Engineers, 1996, p.594-605, 11 refs. Supported by the U.S. Army Cold Regions Research and Engineering Laboratory under Contract No.DACA89-94-K0017.

50-6156

RIVER ICE, ICE BREAKUP, ICE JAMS, ICE FORECASTING, ICE COVER EFFECT, ICE WATER INTERFACE,

RIVER FLOW, FLOOD FORECASTING, HYDRODYNAMICS, MATHEMATICAL MODELS

Field observations have indicated the probability of violent ice runs with extremely high water velocities and rapid water level rises following the release of major ice jams. A complete quantitative description of such an event does not exist due to the difficulties in collecting data on water and ice movements in the field. In this paper, an analytical formulation for ice jam release is presented. A two-dimensional numerical model is developed and used to provide a better understanding on the dynamics of ice jam release.

MP 3861

EVALUATION OF FLOW RESISTANCE IN ICE-COVERED CHANNELS.

Braileanu, F., Ettema, R., Wuebben, J., International Conference on Cold Regions Engineering, 8th, Fairbanks, AK, Aug. 12-16, 1996. Proceedings. Cold regions infrastructure: an international imperative for the 21st century. Edited by R.F. Carlson, New York, American Society of Civil Engineers, 1996, p.606-616, 13 refs.

50-6157

CHANNELS (WATERWAYS), RIVER ICE, ICE COVER EFFECT, ICE BOTTOM SURFACE, ICE WATER INTERFACE, TURBULENT BOUNDARY LAYER, RIVER FLOW, MATHEMATICAL MODELS

Considerable debate surrounds the evaluation of boundary roughness, and hence flow resistance, in ice-covered channels. The debate revolves around how to characterize and combine the influences on flow resistance of bed and ice-cover roughnesses. The highly variable nature of boundary roughness and the empirical framework of all resistance relationships amplify the debate. The present paper addresses the debate and suggests it is time to move on from the customary use resistance equations (for example, the Sabanev equation) based on Manning coefficients.

MP 3862

NEW, LOW-COST ICE CONTROL STRUCTURE. PART 1: CONCEPT DEVELOPMENT.

Lever, J.H., Gooch, G., Tuthill, A.M., International Conference on Cold Regions Engineering, 8th, Fairbanks, AK, Aug. 12-16, 1996. Proceedings. Cold regions infrastructure: an international imperative for the 21st century. Edited by R.F. Carlson, New York, American Society of Civil Engineers, 1996, p. 617-628, 13 refs.

50-6158

RIVER ICE, ICE BREAKUP, ICE JAMS, ICE CONTROL, HYDRAULIC STRUCTURES, ROCK FILLS, SPILLWAYS, FLOOD CONTROL, COST ANALYSIS

Communities located on small, northern rivers can experience severe breakup ice jams. While flood damages may be significant locally, they are often too low to justify conventional flood-control structures. Environmental concerns also tend to render these structures unattractive. The authors have developed a new, low-cost structure to control breakup ice jams on small rivers. It consists of massive sloped blocks, partially buried in riprap, placed across the river adjacent to a natural floodplain. The blocks will arrest a breakup ice run and form a stable, partially grounded ice jam. Trees or boulders on the floodplain retain ice pieces in the river channel while allowing flow to bypass the structure. Large gaps between blocks allow easy fish and canoe passage. Part 1 of this paper describes the development of this concept, and Part 2 describes its full-scale performance.

MP 3863

NEW, LOW-COST ICE CONTROL STRUCTURE. PART 2: CONSTRUCTION AND PERFORMANCE.

Lever, J.H., Gooch, G., Clark, C., International Conference on Cold Regions Engineering, 8th, Fairbanks, AK, Aug. 12-16, 1996. Proceedings. Cold regions infrastructure: an international imperative for the 21st century. Edited by R.F. Carlson, New York, American Society of Civil Engineers, 1996, p. 629-639, 6 refs.

50-6159

RIVER ICE, ICE BREAKUP, ICE JAMS, ICE CONTROL, HYDRAULIC STRUCTURES, ROCK FILLS, SPILLWAYS, FLOOD CONTROL, COST ANALYSIS, UNITED STATES—VERMONT

Hardwick, VT, on the Lamoille River, has experienced 10 ice-jam floods in the past 30 years, yet damages are insufficient to justify conventional flood-control measures. The authors constructed a new ice-control structure (ICS) in Hardwick, in partnership with the Town and the Federal Emergency Management Agency, to assess its potential to control breakup ice jams. It consists of four massive, slope-faced granite blocks, spaced across a 27-m wide river section adjacent to a treed floodplain, and cost \$100,000, exclusive of land and design costs. The authors instrumented the site with pressure transducers and a video camera to record the performance of the new structure. The ICS experienced two mild breakup events during its first year of operation and held an ice jam for several hours during the more severe one. No flooding

occurred downstream during these events. The field performance of the structure was similar to hydraulic model results for cases of thin, weak ice.

MP 3864

OPEN GRADED BASE TO REDUCE THAW WEAKENING IN FLEXIBLE PAVEMENTS.

Kestler, M.A., International Conference on Cold Regions Engineering, 8th, Fairbanks, AK, Aug. 12-16, 1996. Proceedings. Cold regions infrastructure: an international imperative for the 21st century. Edited by R.F. Carlson, New York, American Society of Civil Engineers, 1996, p.878-889, 7 refs.

50-6179

PAVEMENTS, SUBGRADE SOILS, SOIL FREEZING, FROST HEAVE, THAW WEAKENING, FROST PROTECTION, SUBSURFACE DRAINAGE, WATERPROOFING, SUBGRADE MAINTENANCE, ROAD MAINTENANCE, UNITED STATES—NEW HAMPSHIRE
Open Graded Bases (OGB) and Rapid Draining Material (RDM) to promote horizontal drainage of water from pavement systems have not been used extensively in the United States until recently. Drainage layers are now required beneath most Army and Air Force pavements, whether rigid or flexible. To assess the effectiveness of an OGB within a flexible pavement in areas of seasonal freezing and to ultimately evaluate the optimum OGB location within a pavement structure, three test sections with an OGB layer at different depths within the pavement structure were constructed on a USDA Forest Service Road in Berlin, NH. The sections were monitored for surface and subsurface temperature, moisture content, frost heave, pavement stiffness, and meltwater (water introduced by freeze-thaw cycles) collected in the drainage layer. Compilation of field data from these sections constitutes the first in a series of steps to determine the optimum location within a pavement system (in areas of seasonal frost) for OGB placement. This paper discusses drainage test section design, construction, instrumentation, observations to date, and overall strategy for determining the optimal OGB location.

MP 3865

LOW TEMPERATURE CRACKING AND RUTTING IN ASPHALT CONCRETE PAVEMENTS.

Vinson, T.S., Hicks, R.G., Janoo, V.C., Technical Council on Cold Regions Engineering monograph. Roads and airfields in cold regions. Edited by T.S. Vinson, J.W. Rooney, and W.H. Haas, New York, American Society of Civil Engineers, 1996, p.203-248, Refs. p.242-248.

50-6192

BITUMINOUS CONCRETES, CONCRETE PAVEMENTS, CONCRETE STRENGTH, CONCRETE DURABILITY, FROST RESISTANCE, RUNWAYS, COLD WEATHER CONSTRUCTION, LOW TEMPERATURE TESTS, THERMAL STRESSES, CRACK PROPAGATION, ROAD MAINTENANCE

Asphalt concrete (AC) pavements in cold regions can experience two types of distress that are historically considered to be related to temperature, namely, low temperature cracking and rutting. At the present time the material factors that influence the resistance of an AC mixture to low temperature cracking are reasonably well understood. The temperature susceptibility of the asphalt cement is the primary factor. Rutting under traffic loading is related to the gradational and fracture characteristics of the aggregate in the AC mixture and not of the asphalt cement alone. A number of design approaches which incorporate the results from laboratory tests on the asphalt cement or the AC mixture are available to the cold regions engineer to minimize the potential for low temperature cracking and rutting distress in an AC pavement structure.

MP 3866

MATERIAL PROPERTIES, SPECIFICATIONS AND TESTING FOR PAVEMENTS IN COLD REGIONS.

Chamberlain, E.J., Janoo, V.C., Ketcham, S.A., Technical Council on Cold Regions Engineering monograph. Roads and airfields in cold regions. Edited by T.S. Vinson, J.W. Rooney, and W.H. Haas, New York, American Society of Civil Engineers, 1996, p.289-318, Refs. p.314-318.

50-6195

BITUMENS, PAVEMENTS, CONCRETE PAVEMENTS, CONCRETE FREEZING, FROST RESISTANCE, FROST PROTECTION, FREEZE THAW TESTS, COLD WEATHER TESTS, RUNWAYS, ROAD MAINTENANCE
Pavements in cold regions are subjected to annual freeze thaw cycles. The material properties are affected by the changing in-situ temperature and moisture conditions. These materials need to be characterized as a function of temperature and moisture. This section reviews current material specifications and testing for pavements in cold regions.

MP 3867

DESIGN AND ANALYSIS OF A LOW SPEED DRAG PLOW FOR USE IN DEEP SNOW.

Walsh, M.R., Hanover, Dartmouth College, June

1991, 130p., ME. thesis. 13 refs. For another version see 47-1894.

50-6198

SNOW VEHICLES, MILITARY EQUIPMENT, MILITARY RESEARCH, SNOW REMOVAL EQUIPMENT, MECHANICAL PROPERTIES, ALL TERRAIN VEHICLES, SNOW ROADS, TRAFFICABILITY, MECHANICAL TESTS, DESIGN, SNOW MECHANICS, TRACTION, ICE SOLID INTERFACE

Off-road winter logistical operations for the U.S. Army's Sixth Infantry Division (Light) are limited due to equipment restrictions and snow depth. Only one vehicle, the Small Unit Support Vehicle (SUSV), is capable of maneuvering in snow deeper than 20 cm. For successful winter deployment, a method of enabling the use of wheeled vehicles off road was required. The concept of an independent drag-plow attached to the pintel mount of the SUSV was proposed to accomplish this task. Small scale testing revealed severe stability problems with a towed wedge-shaped plow. Parameters measured during testing included pitch and roll angles, drawbar forces, speed, plowed path geometry, and snow characteristics. These parameters were used to determine the feasibility of a full scale model capable of plowing a 2.45 m path in 1 m deep low density snow, leaving 15 cm of snow as ground cover. Results of the half-scale tests were very encouraging. The model performed well in medium density snow. Plow penetration was limited by a geometric constraint of the 4-bar linkage, with 15° the approximate maximum link angle from horizontal. Pitch and roll stability in off road applications were excellent, with the plow demonstrating an ability to right itself and dig in after encountering obstacles. Successful half-scale tests have proven the concept of utilizing a SUSV-towed V-plow for clearing access roads in deep snow for off-road winter operations. Data extrapolation of half-scale tests demonstrate that a full scale plow is feasible.

MP 3868

COLD REGIONS ENGINEERING RESEARCH—A STRATEGIC PLAN.

Carlson, R.F., ed, Zarling, J.P., ed, Link, L.E., ed, University of Alaska, Fairbanks. Institute of Northern Engineering. Report 201, [1988], 27p., Proceedings of a workshop, Hanover, NH, Nov. 30-Dec. 1-2, 1988. 5 refs. For another source see 44-1761.

50-6209

MEETINGS, RESEARCH PROJECTS, COLD WEATHER OPERATION, COLD WEATHER CONSTRUCTION, ENGINEERING, OFFSHORE STRUCTURES, WATERSHEDS, TRANSPORTATION, CLIMATOLOGY, ENVIRONMENTAL PROTECTION

MP 3869

RELATION BETWEEN THE SALINITY OF SEA ICE AND THE EXTINCTION COEFFICIENT AT 6328 Å. [Vliianie solenosti morskogo l'da na opticheskuu ekstinktsiu s dlinoi volny 6328 Å] Davis, H., Munis, R., *Leningrad. Arkhticheskii i antarkhticheskii nauchno-issledovatel'skii institut. Trudy*, 1975, Vol.326, p.66-70, In Russian. 2 refs.

30-3610

HEAT BALANCE, TEST EQUIPMENT, LABORATORY TECHNIQUES, ICE OPTICS, ICE (CONSTRUCTION MATERIAL), LASERS, SEA ICE, ICE PHYSICS, ICE SALINITY

MP 3870

PRELIMINARY RESULTS OF TRITIUM ANALYSES IN BASAL ICE, MATANUSKA GLACIER, ALASKA, U.S.A.: EVIDENCE FOR SUBGLACIAL ICE ACCRETION.

Strasser, J.C., Lawson, D.E., Larson, G.J., Evenson, E.B., Alley, R.B., *Annals of glaciology*, 1996, Vol.22, International Symposium on Glacial Erosion and Sedimentation, Reykjavik, Iceland, Aug. 20-25, 1995. Proceedings. Edited by D. Collins et al, p.126-133, 30 refs.

50-6250

GLACIOLOGY, GLACIAL GEOLOGY, GLACIAL HYDROLOGY, BOTTOM ICE, SUBGLACIAL DRAINAGE, ICE ACCRETION, SEDIMENT TRANSPORT, SUPERCOOLING, REGELATION, ICE COMPOSITION, RADIOACTIVE ISOTOPES, ISOTOPE ANALYSIS, FALLOUT, UNITED STATES—ALASKA—MATANUSKA GLACIER

The stratified-facies ice of the basal zone of Matanuska Glacier, AK, U.S.A., contains significant concentrations of anthropogenic tritium, whereas unaltered englacial-zone ice is devoid of tritium. Supercooled water flowing through subglacial conduits during the melt season likewise contains tritium, as does frazil and other platy ice that nucleates and grows within this subglacially flowing water. These initial results demonstrate net accretion of more than 1.4 m of stratified basal-zone ice since initiation of above-ground thermonuclear bomb testing in 1952. Furthermore, the results support a theory of basal ice formation by ice accretion and debris entrainment from supercooled water within a distributed subglacial drainage system.

MP 3871

NATURE OF BASAL DEBRIS IN THE GISP2 AND BYRD ICE CORES AND ITS RELEVANCE TO BED PROCESSES.

Gow, A.J., Meese, D.A., *Annals of glaciology*, 1996, Vol.22, International Symposium on Glacial Erosion and Sedimentation, Reykjavik, Iceland, Aug. 20-25, 1995. Proceedings. Edited by D. Collins et al, p.134-140, 11 refs.

50-6251

GLACIOLOGY, GLACIAL GEOLOGY, GLACIAL HYDROLOGY, GLACIER BEDS, ICE SOLID INTERFACE, BOTTOM ICE, MELT WATER, REGELATION, ICE CORES, STRATIGRAPHY, ICE COMPOSITION, SEDIMENTATION, ANTARCTICA—BYRD STATION, GREENLAND—SUMMIT

Successful core-drilling to bedrock of both the Greenland and antarctic ice sheets offers unique opportunities for examining processes acting at the bed. At Byrd Station, penetration of the bed was accompanied by upwelling of glacial meltwater into the drillhole. The sediment confirms that incorporation of the debris occurred simultaneously with periodic "freeze-on" of basal meltwater. Currently, the presence of substantial meltwater at the ice/rock interface likely precludes any erosive activity at the bed. At GISP2 in Greenland, basal silty ice 13.1 m thick is currently frozen to the bed at -9°C. Limited studies of the silty ice at GISP2 together with results of more comprehensive investigations obtained by GRIP researchers on basal ice at a companion site at Summit, indicate that the sediment-bearing basal ice likely formed in the absence of an ice sheet and was therefore unrelated to direct interaction of the present ice sheet with its bed. The fact that the basal ice at Summit is frozen to the bottom also precludes any likelihood of erosive activity at the bed. (Auth. mod.)

MP 3872

MORAINAL-BANK SEDIMENT BUDGETS AND THEIR INFLUENCE ON THE STABILITY OF TIDEWATER TERMINI OF VALLEY GLACIERS ENTERING GLACIER BAY, ALASKA, U.S.A.

Hunter, L.E., Powell, R.D., Lawson, D.E., *Annals of glaciology*, 1996, Vol.22, International Symposium on Glacial Erosion and Sedimentation, Reykjavik, Iceland, Aug. 20-25, 1995. Proceedings. Edited by D. Collins et al, p.211-216, 34 refs.

50-6263

GLACIOLOGY, GLACIAL GEOLOGY, GLACIER FLOW, STABILITY, MARINE DEPOSITS, BOTTOM SEDIMENT, MORAINES, SEDIMENT TRANSPORT, GROUND ICE, ICE WATER INTERFACE, CALVING, MASS TRANSFER, SAMPLING, UNITED STATES—ALASKA—GLACIER BAY

MP 3873

FIELD AND LABORATORY EXPERIMENTS AND MODELING OF THE CONSTITUTIVE BEHAVIOR OF SEA ICE.

Cole, D.M., Sea Ice Mechanics and Arctic Modeling Workshop, Anchorage, AK, Apr. 25-28, 1995. Proceedings. Vol.1, Bellevue, WA, Northwest Research Associates, Inc., 1995, p.101-109, 8 refs.

50-6280

SALT ICE, ICE COVER STRENGTH, ICE STRUCTURE, ICE LOADS, ICE PRESSURE, ICE ELASTICITY, ICE DEFORMATION, ICE CREEP, ICE MODELS, MATHEMATICAL MODELS

MP 3874

PACK ICE STRESSES AND THEIR RELATIONSHIP TO REGIONAL DEFORMATION.

Richter-Menge, J.A., Elder, B.C., Tucker, W.B., Perovich, D.K., Sea Ice Mechanics and Arctic Modeling Workshop, Anchorage, AK, Apr. 25-28, 1995. Proceedings. Vol.1, Bellevue, WA, Northwest Research Associates, Inc., 1995, p.178-187, 13 refs.

50-6287

PACK ICE, ICE FLOES, ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE DEFORMATION, STRESS CONCENTRATION, STRAIN MEASURING INSTRUMENTS

MP 3875

NUMERICAL SIMULATION OF ARCTIC PRESSURE RIDGING.

Hopkins, M.A., Sea Ice Mechanics and Arctic Modeling Workshop, Anchorage, AK, Apr. 25-28, 1995. Proceedings. Vol.1, Bellevue, WA, Northwest Research Associates, Inc., 1995, p.199-208, 8 refs.

50-6289

ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE DEFORMATION, ICE OVERRIDE, PRESSURE RIDGES, ICE MODELS, MATHEMATICAL MODELS, COMPUTERIZED SIMULATION

MP 3876

PANEL REPORT ON THE 10 KM SCALE—FLOE CLUSTER.

Overland, J.E., Kerman, B.R., Richter-Menge, J.A., Cox, G., Sea Ice Mechanics and Arctic Modeling Workshop, Anchorage, AK, Apr. 25-28, 1995. Proceedings. Vol.2, Bellevue, WA, Northwest Research Associates, Inc., 1995, p.16-21.

50-6296

ICE FLOES, ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE DEFORMATION, RESEARCH PROJECTS

MP 3877

REPORT OF THE 1-KM-SCALE PANEL.

Hopkins, M.A., Schmidt, H., Sea Ice Mechanics and Arctic Modeling Workshop, Anchorage, AK, Apr. 25-28, 1995. Proceedings. Vol.2, Bellevue, WA, Northwest Research Associates, Inc., 1995, p.22-27.

50-6297

RESEARCH PROJECTS, ICE FLOES, ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE DEFORMATION, PRESSURE RIDGES, ICE CRACKS

MP 3878

SIMI WORKSHOP PANEL ON THE 1CM-1M (MATERIALS) SCALE.

Schulson, E.M., Cole, D.M., Thomas, G.A.N., Smirnov, V.N., Sea Ice Mechanics and Arctic Modeling Workshop, Anchorage, AK, Apr. 25-28, 1995. Proceedings. Vol.2, Bellevue, WA, Northwest Research Associates, Inc., 1995, p.45-59, 13 refs.

50-6299

RESEARCH PROJECTS, ICE STRUCTURE, ICE COVER STRENGTH, ICE LOADS, ICE PRESSURE, ICE FRICTION, ICE DEFORMATION, ICE CRACKS, ICE BREAKING, STRESS CONCENTRATION

MP 3879

HEAT BALANCE INTEGRAL METHOD AND FREEZING PROBLEMS.

Lunardini, V.J., International Symposium on Thermal Engineering and Sciences for Cold Regions, 5th, Ottawa, May 19-22, 1996. Proceedings. Edited by Y. Lee and W.L.H. Hallett, Ottawa, University, Department of Mechanical Engineering, 1996, p.1-21, 53 refs.

50-6429

HEAT BALANCE, HEAT TRANSFER, HEAT FLUX, THERMAL CONDUCTIVITY, THERMAL DIFFUSION, PHASE TRANSFORMATIONS, LIQUID SOLID INTERFACES, BOUNDARY VALUE PROBLEMS, ANALYSIS (MATHEMATICS)

This review will examine the approximate technique called the heat balance integral method. The theory behind the method is detailed and appropriate general relations are derived. The method is illustrated by some simple non-phase-change problems and by application to the Neumann problem. These introductory examples illustrate the power and some of the limitations of this approximation. Several methods to broaden the application or increase the accuracy of the basic heat balance integral method are then discussed. Finally, the heat balance integral is applied to a number of important phase-change problems in Cartesian and curvilinear coordinates.

MP 3880

HISTORY OF COLD REGIONS HEAT TRANSFER: CHRONOLOGY.

Cheng, K.C., Yen, Y.C., International Symposium on Thermal Engineering and Sciences for Cold Regions, 5th, Ottawa, May 19-22, 1996. Proceedings. Edited by Y. Lee and W.L.H. Hallett, Ottawa, University, Department of Mechanical Engineering, 1996, p.71-88, 19 refs. + historical citations from 1250 to 1995.

50-6433

HEAT TRANSFER, PHASE TRANSFORMATIONS, ICE FORMATION, COLD WEATHER CONSTRUCTION, LOW TEMPERATURE RESEARCH, RESEARCH PROJECTS, BIBLIOGRAPHIES, HISTORY

An overview of the subject of cold regions heat transfer is presented in the form of a classification of heat transfer phenomena based on ice formation in air, water on the surface of the earth, ground, and life and other problems. A chronology of the historical developments of the theory of heat is also presented to provide some historical perspectives. Some observations on the history of heat transfer from the viewpoint of temperature difference are made.

MP 3881

CLIMATIC WARMING AND THE DEGRADATION OF WARM PERMAFROST.

Lunardini, V.J., International Symposium on Thermal

Engineering and Sciences for Cold Regions, 5th, Ottawa, May 19-22, 1996. Proceedings. Edited by Y. Lee and W.L.H. Hallett, Ottawa, University, Department of Mechanical Engineering, 1996, p.407-414, 18 refs.

50-6482

PERMAFROST DISTRIBUTION, PERMAFROST THICKNESS, PERMAFROST FORECASTING, PERMAFROST HEAT BALANCE, PERMAFROST HEAT TRANSFER, PERMAFROST THERMAL PROPERTIES, FROZEN GROUND TEMPERATURE, GROUND THAWING, GLOBAL WARMING, MATHEMATICAL MODELS

Permafrost is a widespread constituent of the terrestrial environment. It is, by definition, dependent upon the ambient temperature for its existence and properties; hence it is very sensitive to climatic changes. Simple relations based upon conduction heat transfer, with thawing and geothermal heat flow, are presented to predict the transient effects of surface temperature increases on the thermal state of permafrost. The results indicate that, based on the usual global warming scenarios, relatively small amounts of permafrost will disappear within 50-100 years. This is specifically shown for the most thermally sensitive cases, that is, warm or relict permafrost.

MP 3882

MATHEMATICAL MODEL AND THE TAKASHI MODEL OF SOIL FREEZING.

Nakano, Y., International Symposium on Thermal Engineering and Sciences for Cold Regions, 5th, Ottawa, May 19-22, 1996. Proceedings. Edited by Y. Lee and W.L.H. Hallett, Ottawa, University, Department of Mechanical Engineering, 1996, p.432-447, 42 refs.

50-6485

SOIL FREEZING, FREEZING FRONT, FROST PENETRATION, FROST HEAVE, SOIL WATER MIGRATION, LOAMS, FROZEN GROUND THERMODYNAMICS, FROZEN GROUND TEMPERATURE, FROZEN GROUND STRENGTH, FROZEN GROUND COMPRESSION, MATHEMATICAL MODELS

Around 1980 the Takashi model of soil freezing was introduced and today this model is the standard of engineering design in Japan. According to this model, the freezing characteristics of a given soil are described by two empirical formulas that specify the dependence of the frost heave ratio and the water intake ratio on given thermal and hydraulic conditions. In this work two theoretical formulas approximately corresponding to the Takashi's empirical formulas are derived by using the mathematical model called M_1 . The theoretical formulas are compared with the empirical ones for Kanto loam. The agreement between them is found to be satisfactory.

MP 3883

DESCRIPTION OF THE SNOW COVER ON THE WINTER SEA ICE OF THE AMUNDSEN AND ROSS SEAS.

Sturm, M., Morris, K., Massom, R., *Antarctic journal of the United States*, 1995, 30(1-4), p.21-24, 13 refs.

50-6505

SNOW DEPTH, SEA ICE, ICE COVER THICKNESS, SNOW STRATIGRAPHY, SNOW ICE INTERFACE, GRAIN SIZE, SNOW COVER, ANTARCTICA—AMUNDSEN SEA, ANTARCTICA—ROSS SEA

Combined snow and sea-ice studies were conducted from the R/V *Nathaniel B. Palmer* in the pack ice of the Amundsen and Ross seas between Sep. 10 and Oct. 21, 1994. In all, measurements were made in 139 snow pits and 21 trenches (mean depth: 32.4 cm). In total, 2,400 measurements of snow depth and snow-ice interface temperatures were made. In general, the snow cover comprised four distinctly different types of snow: soft or moderately hard fine-grained snow layers; depth hoar layers; icy layers, melt-clusters, and percolation columns; and new or recent snow. The icy features exhibited textures suggestive of formation during high winds.

MP 3884

PEGASUS: A GLACIAL-ICE RUNWAY FOR WHEELED FLIGHT OPERATIONS AT MCMURDO STATION.

Blaisdell, G.L., Lang, R.M., *Antarctic journal of the United States*, 1995, 30(1-4), p.7-10.

50-6501

ICE RUNWAYS, COLD WEATHER CONSTRUCTION, GLACIER ICE, AIRCRAFT LANDING AREAS, ICE STRENGTH, HARDNESS TESTS, TEST EQUIPMENT, CONSTRUCTION EQUIPMENT, ANTARCTICA—MCMURDO STATION

The McMurdo Station glacial-ice runway was developed over a 5-year period and now provides access to heavy wheeled aircraft for much of the austral summer field season. Benefits of the runway include reduced wear and tear on airframes, more efficient use of aircraft and flight crews, less wasted time by science and support personnel, enhanced morale, assurance of stocking South Pole before station closings, increased efficiency for cargo handlers, and timely station close-out. Access by much of the world's air-

craft and the potential for winter flights are also gained. To date, about 78 flights have operated from the glacial-ice runway yielding a savings of 39 flights.

MP 3885

FACIES ARCHITECTURE AND GROUNDING-LINE FAN PROCESSES OF MORAINAL BANKS DURING THE DEGLACIATION OF COASTAL MAINE.

Hunter, L.E., Powell, R.D., Smith, G.W., *Geological Society of America. Bulletin*, Aug. 1996, 108(8), p.1022-1038, Refs. p.1037-1038.

50-6532

PLEISTOCENE, MARINE GEOLOGY, GLACIAL GEOLOGY, GLACIAL DEPOSITS, OCEAN CURRENTS, TURBULENT DIFFUSION, SEDIMENT TRANSPORT, MORAINES, STRATIGRAPHY, GLACIER MELTING, GROUND ICE, UNITED STATES—MAINE

Submarine jet processes are inferred from glaciomarine facies exposed in gravel pits in southwestern coastal Maine. The geometry and distribution of fan facies depend on (1) the proximity to the grounding line and stream effluxes, (2) the angle of jet trajectory from glacier conduits, and (3) sediment remobilization processes. Syndepositional glaciotectionic deformation further augments morainal bank formation through pushing and squeezing of fan sediments at the grounding line. Complex process-sediment interactions along the temperate tidewater margin of the Laurentide ice sheet are recorded in the facies architecture of sedimentary sequences in morainal banks. Morainal bank accumulation was governed by rapid fluvial deposition and by outwash jet dynamics that controlled the spatial distribution of sedimentary facies. Near the grounding line, meltwater dynamics change rapidly where sediment-laden fresh water is discharged at or near the sea floor. Jet trajectory relative to the morainal-bank slope determines whether a jet will make contact with the morainal bank. Below these buoyant jets, backflow eddies can produce currents that drive ripple migration toward the grounding line. Abrupt facies changes record fluctuations in jet discharge and trajectory and sediment redistribution by sediment gravity flows initiated near the grounding line.

MP 3886

NEW FORMULATION FOR THE BOWEN RATIO OVER SATURATED SURFACES.

Andreas, E.L., Cash, B.A., *Journal of applied meteorology*, Aug. 1996, 35(8), p.1279-1289, 34 refs.

50-6570

CLIMATOLOGY, ATMOSPHERIC BOUNDARY LAYER, SURFACE TEMPERATURE, FORECASTING, HEAT FLUX, LATENT HEAT, TURBULENT FLOW, AIR ICE WATER INTERACTION, SNOW COVER EFFECT, INDEXES (RATIOS), ANALYSIS (MATHEMATICS)

Analytical expressions are presented for calculating the Bowen ratio, $Bo = H_s/H_L$, from a quantity that is derived primarily from the surface temperature T_s and the assumption that the near-surface air is saturated (but not supersaturated) with water vapor. Here H_s is the surface sensible heat flux and H_L is the surface latent heat flux. These analytical expressions taken from the literature came from experiments over snow-covered and sea ice and over water in the Great Lakes, the marginal seas, and the open ocean at a variety of latitudes including Antarctica. This analysis suggests that the analytical expressions should generally predict Bo to better than $\pm 40\%$. It is concluded that predicting Bo from surface temperature alone yields good results for large-scale or longer time (e.g., daily) averages but is less accurate when both the spatial and temporal averaging are limited. Consequently, the results will probably find most use in global climate models, in coupled ice-ocean-atmosphere models, and for data assimilation and quality control. (Auth. mod.)

MP 3887

CORRECTION TO "CALCULATION OF TEMPERATURE EFFECTS ON WETTING COEFFICIENTS OF POROUS SOLIDS AND THEIR CAPILLARY PRESSURE FUNCTIONS" BY STEVEN A. GRANT AND AMIR SALEHZA-

DEH. *Water resources research*, May 1996, 32(5), p.1477, 1 ref. For pertinent paper see 50-5965.

50-5968

SOIL PHYSICS, CAPILLARITY, TEMPERATURE EFFECTS, MATHEMATICAL MODELS

MP 3888

STRENGTH AND VISCOSITY OF ICE.

[Prochnost' i вязкость l'da]

Zaretskiĭ, I.U.K., Fish, A.M., *Materialy Pervoi konferentsii geokriologov Rossii*, 3-5 iyunia 1996 g., MGU im.

M.V. Lomonosova, Kniga 2 (Proceedings of the First Conference of Russian Geocryologists, June 3-5, 1996, Moscow State University, Volume 2), Moscow, MGU geologicheskii fakul'tet, kafedra geokriologii, 1996, p.170-182, In Russian.

50-6825

GEOCRYOLOGY, ICE STRENGTH, VISCOSITY, TEMPERATURE EFFECTS, STRESS STRAIN DIAGRAMS, ICE

PLASTICITY, ICE DEFORMATION, SHEAR STRENGTH, ICE MECHANICS

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